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VIEWS, NEWS AND INTERVIEWS.

A lady from Providence, R. I., had been in New York on a shopping expedition, and, upon her return, was going through the usual catechism as to what she did and saw in the metropolis. "Did you ride in an electric cab?" asked her son. "Electric cab?" said she. "No, I don't think I saw any."

"Why, the streets are full of them. They look like a Franklin stove on four big, fat wheels."

"Oh! Are those electric cabs? I saw lots of them, but I thought they were steam road-rollers."

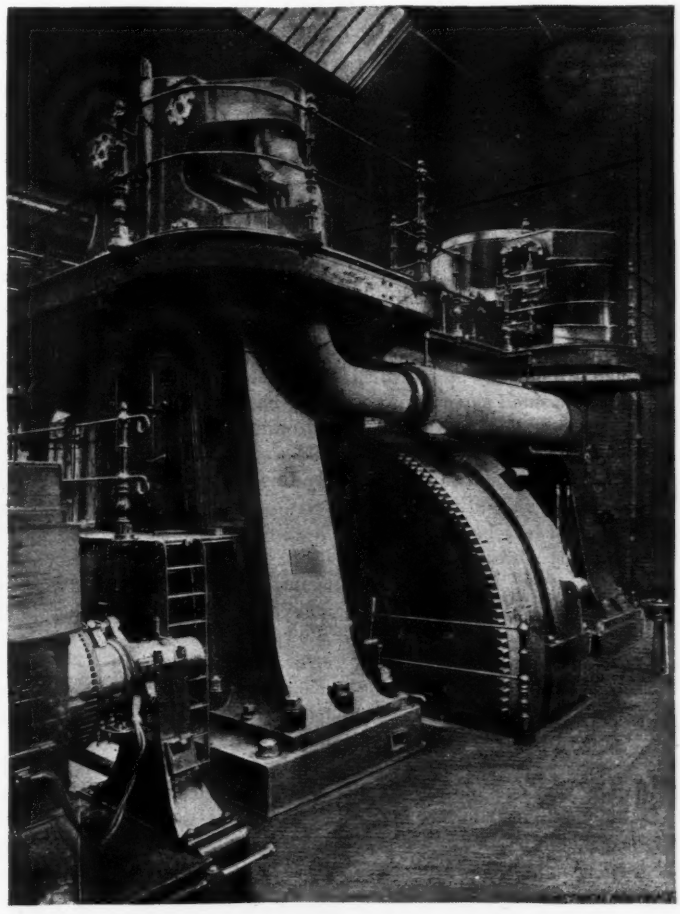
Gen. Greeley does not think much of the Marconi system of telegraphy. He knows that to get much result at Washington, one must get hold of the wires.—*Boston Advertiser.*

Admiral Lord Charles Beresford, in his recent book, says: "There is no country which I have visited where electricity as a motive power has been taken advantage of to the same extent as in Japan for the furtherance and development of trade and commerce. Telephones and telegraphs abound in every street in nearly every town throughout the empire, and a very large and increasing number of manufactures are worked by electric power. I made many inquiries as to the original outlay and working expenses, comparing electricity with steam power, and taking all circumstances into consideration, the former is unquestionably the cheaper."

Queen Victoria has overcome her dislike to the electric light, which is now in use in all her palaces. The Albert Memorial Chapel at Windsor Castle (where the Dukes of Albany and Clarence are buried) is now being lighted by electricity, which will shortly be extended to St. George's Chapel.

It has been the fashion for several years to hold horse shows in Madison Square Garden, the building in which the New York Electrical Exhibition is now going on. Meanwhile a horse show is being held in an open-air enclosure about eight miles further uptown. A few nights ago a gentleman from Chicago, interested in horses, arrived in the city, bought a box at the horse show for himself and family, dined in a hurry, dressed and appeared at the Garden door about nine o'clock with his family and the box ticket. After some argument he was admitted, but the nearest thing to horses that he saw were electric automobiles. Chicago men act quickly. He became interested, lingered an hour, rode back with his wife and children to their hotel in an automobile, wrote out a check for the price of it, and ordered it shipped to Chicago at once.

A novel application of the electric motor is its combination with a portable planing machine, to plane decks and floors. The machine has somewhat the appearance of a large lawn-mower, being mounted on wheels, and having two handles, by which it may be pushed about. A switch is arranged near the left handle, and the motor is belted directly to the cutting cylinder. By using an auxiliary cylinder it is possible to cut in close to walls, and the machine is adjustable for depth of cut and speed. Pushing the machine away from the operator the knives will cut, while, if it is pulled towards him, they will be raised clear of the floor.



A LARGE DIRECT-CONNECTED UNIT AT MANCHESTER, ENGLAND.

The Central Union Telephone Company expects to spend about $1,000,000 in new construction this year.

A Large Electric Lighting Unit at Manchester, England.

Even in these days of large units a description of the plant which has been recently erected at the Manchester Corporation electricity works is of interest. Through the courtesy of Mr. Wordingham we have been enabled to photograph the plant, though, pictorially speaking, the exigencies of space prevent us doing credit to this striking piece of work.

The engine has been made by Messrs. John Musgrave and Sons, Limited, and is of the vertical cross compound type, having cylinders 38 inches and 72 inches diameter, three feet six inches stroke. The engine is made to run at 100 revolutions per minute, and suitable for a boiler pressure of 120 pounds per square inch. Both cylinders are jacketed, both in body and covers, and have double ported Corliss valves, actuated by eccentrics from the crankshaft, and Musgrave's patent automatic trip gear, coupled direct to the governor, which admits the steam to the high-pressure cylinder at two or three pounds less pressure than the boiler pressure. Two stop valves are coupled to the cylinders from the duplicate main range. The normal load of the engine is 2,500 indicated horse-power, but it is capable of giving out fully 25 per cent above this load. A heavy flywheel is keyed to the crankshaft, and the wheel boss is also prepared to fasten to the dynamo. The sides of the engine are entirely enclosed and forced lubrication is adopted. Two ram pumps are fixed on the engine for this purpose, and pump the oil under pressure (which can be regulated at will) to the main bearings under and over, also to the crank pins, cross-head pins and slide blocks. A gage is fixed in the pipes showing the pressure of oil supplied. The engines are very massive in appearance and work noiselessly, and no vibration is discernible. The moving parts of the engines are balanced in the cranks. White anti-friction metal is used in all the bearings. The engine is also supplied with a large platform surrounding both cylinders, and an intermediate platform, to enable the

attendant to get at the cross-head, slides, and indicating apparatus.

The engine is made to work condensing and non-condensing, the condenser being on Korting's principle, and is supplied by water from a large tank over the boiler-house.

The generator was made by the Electric Construction Company, Limited. The normal output is 3,500 amperes at 410 volts, the range of voltage extending to 430 with 4,750 amperes as an emergency load, or with normal output up to 500 volts when required for tramway work. The somewhat high speed of revolution had the effect of limiting the number of poles, which was fixed at 12, each of which is energized by a double-coned shut coil. The yoke frame, on account of its magnitude, and to facilitate erection and accessibility, is divided into six parts, and measures over all 20 feet 6 inches. The total weight of the machine is, approximately 120 tons. The armature core is carried by a balanced center, provided with a double set of arms of oval section. The armature is tunnel wound, and the coils are formed in one piece, i. e., without joint between one commutator segment and another, the commutator itself being 9 feet 10 inches in diameter. The brush gear includes an endless rack operated by worm gear and double hand wheels, so that when standing on the brush platform the attendant may replace old brushes by having the whole of the brush holders successively rotated past him. The current is taken off to the main terminals from the circular, positive and negative brush busbars by special terminal brushes, the current being too large to permit the use of flexible leads. Notwithstanding the magnitude of the machine, the number of parts involved and the diffiulty of erection, it was started under load without incident, and was at once put on to Corporation supply mains, and has been in use almost daily from the end of December until recently, when the exigencies of the load no longer demanded it. The electrical efficiency of the set is over 98 per cent. The commercial efficiency has not yet been determined, owing to the machine having been required for service.—*The (London) Electrical Review.*

The Omaha, Neb., post office is to be equipped with a private branch exchange by the Nebraska Telephone Company. Long distance equipment will be provided and each department will have its own telephone.

IMPORTANCE OF ACCURATE MEASUREMENTS IN CENTRAL LIGHTING STATIONS.

BY J. FRANKLIN STEVENS.

There is no department of a central lighting station which deserves so much careful and skilled attention as the department having charge of tests and measurements, and yet, importance considered, few departments are so seriously neglected. On the accuracy of the measurements made depends the success or failure of the station commercially and scientifically. If inaccurate measurements are made, inaccurate results will be obtained, for a true conclusion was never drawn from a false premise.

Starting with the dynamo, it is perfectly possible to thoroughly test every part of it by means of a portable voltmeter and ammeter. Its insulation, heating limit under various loads, efficiency and regulation may be determined by means of a few simple measurements while the dynamo is in operative condition. Such a set of tests made every day constitute a practical insurance, and frequently save heavy expense bills by showing defects which, if allowed to continue, would eventually result in serious damage, but which may be remedied at the start by a small expenditure.

Daily tests should also be made of all lines and switchboard connections, in order that their condition may be definitely known, and any defects repaired before a heavy load is thrown on them. Many a break-down under full load, with all its consequent trouble and expense, could be saved by spending an hour or so per day in ascertaining the exact condition of generating, transmitting and translating devices. It is, of course, essential that the instruments employed should be accurate and reliable.

The accuracy of the indications of the switchboard instruments is a matter of prime importance, for they stand between the generating and translating devices, and the successful operation of both are dependent on them. Consider for a moment the effect of a two per cent variation from absolute accuracy in the indications of the switchboard voltmeter on a circuit carrying incandescent lamps. An increase of two per cent over the normal voltage means a decrease of 32 per cent in the life factor of the lamp, a variation of six and one-half per cent in the watt consumption per candle-power and 12 per cent in actual candle-power given out. A decrease of two per cent from the normal voltage gives the same variations in the lamp, but in the opposite direction. Investigation will show that many other devices, such as motors or arc lamps, are quite as seriously affected by so small a variation as two per cent from normal voltage, and while the loss of efficiency in each particular device is small, the sum total of all the losses is far from small. Such variations as these would never knowingly be permitted in any well regulated station, yet the average superintendent considers two per cent close enough for a switchboard voltmeter, and frequently is not sure that two per cent is the limit of error.

A corresponding error in the generator or circuit ammeters is not so vitally important, yet it is important that they should be accurate, for they are depended upon to show the load carried by the generator and the relative condition of the various circuits in service.

Since it is not feasible for a central station to calibrate all the instruments in use, it is essential that there should be available a portable voltmeter and ammeter, which can be considered as standards, and for this purpose the best is none too good. These standards should be very carefully handled and should be kept in calibration by a reputable instrument maker. This can be accomplished by sending them out to be checked at least once a year. The regular portables in use, as well as the switchboard instruments, should be checked against these standards frequently and errors noted. It is bad policy to allow any instrument to remain in error, depending on the memory to make corrections, where readings are taken; far better have the instruments made to read correctly.

It may be said that every station superintendent knows all this; possibly he does, but my personal experience has been that the average switchboard voltmeter is more than two per cent in error. I have frequently seen them show errors of five per cent, and, even when this was proved, have occasionally been told that they were near enough for all practical purposes, or that the error would be allowed for in taking readings. The first mistake is frequently due to the fact that the contractor for the plant is permitted to put in "voltmeters and ammeters" without specification as to make, accuracy or principle. As a matter of fact, the selection of instruments should be placed in the hands of a man capable of judging the relative merits of the various makes, either from experience or from a knowledge of the principle employed. In general, the type selected should be one which has proved practicable in actual service; consideration should be given the standing of the maker, and, other things being equal, the simplest system selected. Again, the system should be one not subject to variation with time, and, for switchboard instruments, preferably of the electro magnetic type, the ammeters being series instruments, except where the volume of current to be measured is too great to be successfully measured in this way.

For alternating-current work the electro-magnetic system is by far the most practicable for switchboard instruments. For portables the D'Arsonval system is best adapted for direct-current measurements, and the dynamometer system for alternating current.

Several portables should be available for general testing work, not only for testing the dynamos and lines, but also for testing the efficiency of arc and incandescent lamps, motors, transformers and registering wattmeters. A voltmeter and ammeter will answer for most of the work, but for special testing, special instruments should be provided; for instance, for lamps a direct-reading wattmeter is extremely useful, and for testing transformers an alternating-current milliammeter, by the use of which "idle losses" can be directly determined. Registering wattmeters should be periodically tested and corrected when in error. It is a mistake to try to test wattmeters by the use of lamps, as the current consumption of lamps varies sufficiently to introduce considerable error.

In series arc systems on constant-current regulation a voltmeter should be used. This is even more important than the use of an ammeter on constant potential systems, for by the use of such a voltmeter the exact condition of the circuit can be ascertained, and if the instrument is properly designed it may be used to locate grounds and measure the insulation resistance of the line when the circuit is "alive."

In conclusion, I feel assured that there is no one factor so potent in increasing dividends as accurate measurements inside and outside of the station; nothing should be taken for granted, but everything should be measured and tested. Such a system once established is easy to maintain, and as a result more efficient devices can be purchased, guarantees proved or disproved, and the entire installation held up to the point of maximum efficiency.

Some Special Features at the New York Electrical Exhibition.

An exhibit of unique interest is that of historical arc lamps in the north gallery. The oldest in the series is a hand feed lamp made by Prof. R. Ogden Doremus, and exhibited by him in Brooklyn in 1854. A multiple lamp made by the same experimenter and shown at the same time, 45 years ago, is also exhibited, as is a Duboscq lamp of 1855, which was imported about that time by Professor Doremus. A Jablochkoff candle of the type originally used in Paris in 1872 is exhibited.

An interesting lamp is that made at the Wallace factory in 1875, being one of the first four series arc lamps ever made in the United States. It was tested in the presence of a number of the most eminent electricians of that day, and was considered to be a very great advance in arc lighting. This interesting lamp was loaned to the exhibit by Dr. L. H. Laudy.

Mr. S. M. Hamill has kindly loaned for exhibition the first lamp built by Mr. Charles F. Brush. Near this hangs a No. 2 Brush lamp made in 1877, which has been in continuous use for 22 years on the circuits of the Albany Electric Illuminating Company. It was taken down only for the purposes of this exhibition, and was loaned to the exhibit by Mr. Thomas E. Murray.

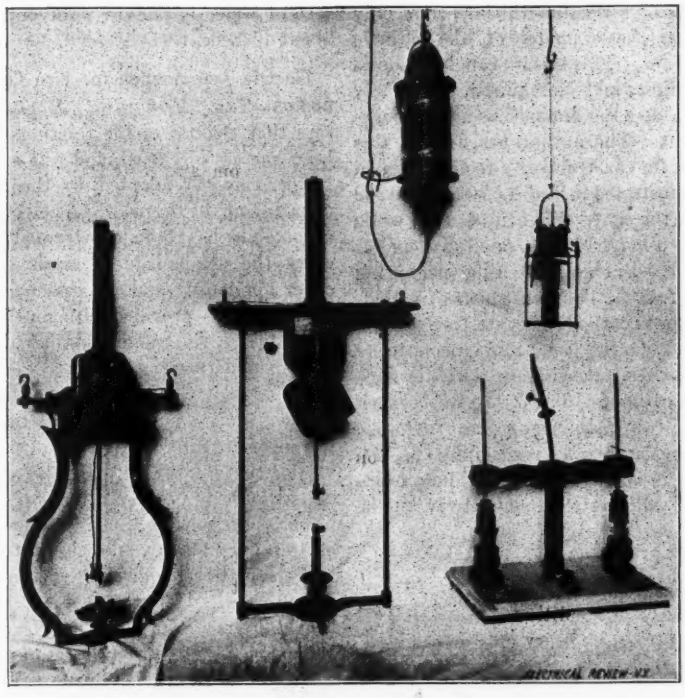
An original Thomson lamp of 1879, which was used with the first of the ball armature three-coil machines—the first dynamo provided with a shunt and regulator of the old Thomson-Houston pattern—a Thomson lamp working on what was then called the "drop and lift" principle, and dating back to 1879, and a Weston lamp of about 1880, complete the exhibit of old lamps. Lamps of more modern type of the following names are also shown:

Shiéf-Bauer, Lemaire, Pieper, Kinsman, Arnoux-Hochhausen, Knight, Ward, Helios, Sterling, Eschweis, Adams-Bagnall Electric Company, Electric Arc Lamp Company, Western Electric Company, General Incandescent Arc Light Company, Haines and General Electric Company.

The exhibit was compiled by Mr. E. F. Peck, of a committee in which he was associated with Mr. C. W. Rice and Mr. George H. Guy.

The government loan exhibit, described in our last week's issue, is still attracting much attention. Great credit is due to Mr. Ira W. Henry, through whose efforts this excellent feature of the show was obtained.

There is a sort of an underground chamber of horrors under the Madison Square Garden, wherein are the exhibits that love the darkness rather than the light. Here may be seen hourly exhibitions of deep sea diving, illustrating the use of various electrical apparatus in this hazardous class of work. The diver, who is a young woman, puts on a regular diving dress which is equipped with an electric lantern, telephone, etc., and descends into a tank about 15 feet deep, which is already inhabited by several large turtles, fish, etc.



Signal Lamp from "Vizcaya." Wallace Series Lamp, 1875.
Thomson Lamp, 1879. Brush Lamp, 1877. Doremus's Lamp, 1854.

SPECIMENS OF HISTORICAL ARC LAMPS.—THE NEW YORK ELECTRICAL EXHIBITION.

THE HISTORICAL ARC LAMP EXHIBIT AT THE NEW YORK ELECTRICAL EXHIBITION.

The other day a young woman visitor while leaning over the top of the tank, and looking at the turtle, lost her bonnet, which fell in the water. In making a frantic plunge for it she further lost her balance and went to the bottom of the tank, where she was in full view of a large crowd of horror-stricken spectators. Capt. Louis Sorcho, the lecturer of the diving exhibit, made a gallant leap to her rescue, and an improvised but exceedingly realistic scene was enacted. No further damage was done than that occasioned by a thorough wetting and shock to the nerves.

In another part of the underground caverns is an exhibition known as the electric cave. This is a passage about three feet wide, on each side of which is hung a large sheet of tin, kept charged to a potential sufficient to spark several inches by a large and powerful static machine outside. At one end of this stands on a stool a man with a stentorian voice, who continually entreats the crowd of visitors to walk through and write their names upon the wall with their fingers. When the unwary visitor goes in and attempts to write his name with his finger he gets a sharp tingling shock and sees bright sparks. Naturally, when there is a crowd in the grotto this spot becomes a scene of wild and hilarious fun, and a constant chorus of squeals and giggles can be heard coming from its stygian depths.

Around the corner is the X-ray exhibit, attached to which is a sign beseeching the multitude to come in and see their bones. A very dark and crooked passage leads past a flat plate fluoroscope, behind which the hand can be inserted and upon which the shadow of the bones can be seen.

Across the hall from this exhibit is a show of electrical stage-lighting effects, very handsomely illustrated by a large number of miniature stage settings from 20 or more different plays. Suspended from the ceiling is a telephone receiver of the loud-speaking variety, connected with a transmitter on top of the large organ in the main hall.

An occasional popping of high-pressure sparks attracts the crowd in front of the high-tension exhibit, which is managed by Mr. W. J. Clarke, and in which is shown experiments and demonstrations with high-tension electricity. The most interesting exhibit in the booth is the Caldwell liquid interrupter, which has already been described at great length in the ELECTRICAL REVIEW. The interrupter is connected with a Thomson induction coil, intended to give normally six-inch sparks, but under

(Continued on page 331.)

SCIENCE BREVITIES.

Temperature Effects on the Magnetic Properties of Iron—Our English contemporary, *Industries and Iron*, describes some work done by Mr. S. R. Roget. He has been conducting experiments on the effects of prolonged heating on the magnetic properties of iron. The temperature of the heating ranged up to 700 degrees centigrade, the temperature being recorded on a Callender-Griffiths platinum pyrometer. There were great differences of behavior shown by the different specimens. The results of the experiments showed the following effects:

1. Material in the annealed state is more liable to change than in a harder state.

2. All the changes produced by prolonged heating are completely removed by reannealing.

3. The heating need not be continuous; the same cumulative effect is produced by a number of short periods at a given temperature as by continuous heating at the same temperature.

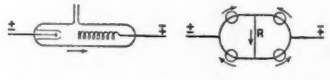
4. The liability of the material to increase in hysteresis at moderate temperatures is not removed by prolonged heating at high temperatures.

5. The change is confined to the lower part of the B-H. curve, the upper part remaining unaltered.

6. The effect is produced equally whether the iron is or is not exposed to the air during heating.

Aluminum Feeders—It is stated in the *Railway and Engineering Review* that the Northwestern Elevated Railway, of Chicago, has entered into a contract for 150,000 pounds of aluminum feeders. Three sizes of bare cables will be used—785,000, 1,000,000 and 1,300,000 circular mils in area, respectively. The largest feeder will be about one and one-half inches in diameter. Of the two larger sizes there will be two cables of more than 10 miles in length each. The feeders will be placed in a wooden box or trough covered by a board walk, between the tracks, and they will be supported on vitrified clay blocks of umbrella shape, placed nine feet apart. The contract was made on the basis that 47 pounds of aluminum are equal in conductive capacity to 100 pounds of copper. Experiments carried out by the electrical engineering department of the road have demonstrated that 157 circular mils of aluminum are equivalent in carrying capacity to 100 circular mils of copper.

A Cathode Ray Rectifier—M. P. Villard, writing in *Comptes Rendus*, showed some time ago that, under a given pressure, the electrical resistance of a vacuum tube depends only upon the diameter of the cathode stream. This stream can be made as feeble as may be required, by suitably choosing the dimensions and arrangement. The author has utilized this fact for constructing a rectifier, which is illustrated in Fig. 1. One electrode has the shape of a coil of wire, while the other ends in a small disk and is enclosed in an inner tube narrowing in front. The consequence is that, whereas cathode rays are freely developed at the coil, they encounter a great resistance when the wire is made the cathode. The difference between the two cases is so great that the spark-lengths corresponding to the two resistances are one millimetre and 150 millimetres respectively. The



FIGS. 1 AND 2.—CATHODE RAY RECTIFIER.

author has effectually applied such a *redresseur* to the working of vacuum tubes, feeding an induction coil simply with an alternating current. Since the fall of potential takes place chiefly in the vacuum tube, the rectifier is not perceptibly heated. The anode is not in any case the seat of any evolution of heat. Fig. 2 shows an arrangement of four rectifiers, by which both oscillations of an alternating current can be utilized.

Electric Pumps for Canals—There is given in the *Revue Industrielle* a full description of the electrical installation for providing water for the Bourgogne Canal. It seems that in certain seasons of the year the natural water supply to the high-level reaches of this canal are deficient. In consequence, a number of electrical pumping plants have been provided at the different locks to raise water from the low to the high levels during those seasons. To admit of this a waterfall near the canal has been used, and power is transmitted from this to the pumping station by means of three-phase currents at 2,000 volts. Centrifugal pumps, driven by motors on the same axles, are used to raise the water. Our contemporary illustrates in detail the electrical and civil engineering works at the generating station and at one pumping station. It also gives figures as to the cost of the working. That of pumping the water at the locks comes out at one-tenth of what it would cost to provide extra water in the main reservoirs. The actual expenditure of raising 35 cubic feet of water is said to work out at about .018 cent.

Electric Automobiles for Fire Companies—The *Mechanical Engineer* says that electric motor traction has been successfully tried, and will soon be permanently adopted, by the fire department in Paris. An electric automobile has been constructed to carry the escape-ladders, cords and other appliances and 11 passengers. The vehicle is provided with an electric motor, the accumulators being placed underneath the body of the carriage in which stands the fire-escape. When put through its trials the new car, fully equipped and conveying the engineer, the brigade officer, his orderly and eight firemen, behaved very well, keeping up a speed of 15 miles an hour, and negotiating inclines without difficulty. The new motor car will be put into use at the headquarters of the Paris fire brigade. It is expected that all the stations of the city will be provided with similar vehicles in due course.

The Wehnelt Interrupter—Mr. J. Macintyre, in a letter to *Nature*, points to various methods of controlling the Wehnelt interrupter with a view to preventing the destruction of Crookes tubes connected with that instrument He says:

The principle upon which the experiments were conducted was to keep all the factors constant with one exception, the amperage, voltage, results upon the fluorescent screen and photographic plate being carefully noted and registered by means of an X-ray meter. In one set of experiments the voltage was varied, in another the density of the solution, in the third the size of the platinum, in the fourth the self-induction of the primary coil. By varying any of these, or by a combination specially suited for different purposes, complete control of the Wehnelt was obtained in the way of greater or less fluorescence, actinic power and steadiness of the screen. Briefly stated, it was found that all these effects decreased as we lowered the voltage, the self-induction of the primary, the density of the electrolyte and the size of the platinum.

Early in these investigations great differences between the readings across the Wehnelt and those across the terminals of the primary were observed, for the most part indicating increase in the former. An extended series of observations was made by means of Lord Kelvin's electro-static voltmeters and ampere gauge, and a relationship between all the different factors was clearly demonstrated. Different induction coils were used, in one of which the self induction could be altered by withdrawing the soft iron core. Briefly put, it may be said: (*a*) that there was a corresponding decrease in the readings across the Wehnelt as the voltage in the primary decreased; (*b*) different conditions, such as length of spark gap, or different vacuum in the Crookes tube placed in the secondary circuit, affected the readings considerably; (*c*) the increased voltage across the Wehnelt seemed to depend upon the amount of self-induction in the primary. In this group of experiments it was noted that, as the self-induction increased, the voltage increased, the ampearge decreased, and the number of interruptions also decreased. A non inductive resistance was made with a view of confirming the results, and it was used instead of the primary of the ordinary coil. In this there was, however, sufficient self-induction to work the Wehnelt under certain conditions. With this arrangement, not a single reading across the Wehnelt was higher than that of the voltage across the primary.

Compressed Air—Our London namesake, in an editorial note on this subject, says:

Compressed air has such a multitude of uses that we think it is something of a mistake to push its use in general tramway traction. Air loses much in compression and reexpansion, and this very fact makes it more valuable in certain situations, such as mining, than any other agent, for it affords a much needed ventilation, and serves also as a cooling agent. Like electricity, compressed air is, after all, merely a medium of power transference; it is not a prime mover, but it absorbs power, and gives it out again, and certain losses are inevitable in the process just as they are in the manufacture and transport and use of electricity. But the loss in air is very great. Work goes in the shape of heat, and it goes in large quantity. But this is no argument against the use of air, and may be an argument at times in its favor. Compressed air is supplemental to electricity. They are rather allies than rivals, and both have done much in industry, and are likely to do very much more than they have already accomplished.

Gigantic Gas Engines.

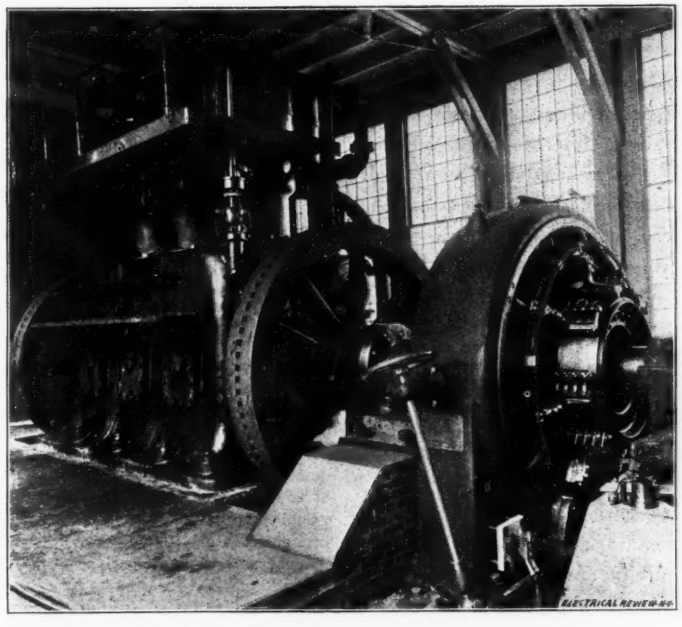
The internal combustion motor, or gas engine, has so many advantages of economy, simplicity, compactness and readiness over the ordinary forms of steam engines, that its perfection has engaged the attention of designers for several years past. While the smaller sizes of such engines have been well worked out and brought to a highly satisfactory state of development, the larger sizes, those capable of being used in commercial-scale electric lighting or street-railway work, have been more slowly progressing toward that point of reliability and regulation that will make them competitors of steam.

The Westinghouse Machine Company, Pittsburgh, Pa., have lately devoted much attention to the production of large gas engines, the illustration showing one of their recent types, the largest engine of its kind yet built. The engine is of 650 brake horse-power, is direct connected to an electric generator and has been in operation in the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, for over a year. This engine has a speed of 150 revolutions per minute, and is of the vertical, three-cylinder type, with two overhanging flywheels. It is direct-connected to an eight-pole, 400-kilowatt, 550-volt generator, capable of carrying 30 per cent continuous overload. In general outline and design this engine embodies the main mechanical features of the Westinghouse steam engine. The upright self contained construction and the self-lubricating features have both been followed.

The cylinders are so arranged that with each revolution of the engine shaft an explosion of gas occurs, an electric sparking device, or igniter, causes the ignition of the gas. The working stroke of the piston alternates so that an impulse is received with each revolution permitting a very close regulation of speed. A sensitive governor regulates the amount of the explosive mixture admitted with each stroke, and thus closely controls the force of the explosion. The fluctuations from overload to no load are not accompanied by the reduction in the number of impulses, but by the admission to the cylinder of a smaller charge of the explosive mixture.

Owing to these two factors of regulation the engine is eminently fitted for direct-connection to electric generators. Westinghouse gas engines of smaller sizes have been fitted with great success to dynamos for supplying electricity to private houses and hotels.

The size of gas engines is being constantly increased. Recently the Columbus Light and Power Company, of Columbus, Ohio, ordered two Westinghouse gas engines, one of 650 horse-power and the other of 280 horse-power, to be direct-connected to electric generators. This order was given after a thorough examination had been made of the large gas engines which have been in operation for from one to two years. A contract has also been received for a gas engine of 280 horse-power for the Consolidated Gas Company, of Long Branch, N. J. This will be direct-connected to an electric generator for supplying electric light.



A 650-Horse-Power Direct-Coupled Gas Engine.

The demand for gas and steam engines, for both foreign countries and the United States, has greatly increased during recent months. To meet this increased demand, the Westinghouse Machine Company are doubling the size of their works at East Pittsburgh.

Electric Fans in the Philippines.

In the letters home of a soldier with the troops in the Philippines he tells of his joy, while wounded, in seeing a little electric fan placed in the hospital where he was lying. He was able after a few days to get over to it, and the nurse allowed the breeze from it to cool his fevered brow and blow his hair about. He said it was like a breath from home, and put him in mind of Coney Island. The soldier is not the first one who has spoken of the fan as like Coney Island.

The Radiophone at the New York Electrical Exhibition.

Among the most attractive features of the exhibition is the radiophone, an instrument whereby speech is transmitted over a beam of light. The apparatus is installed in the upper gallery between two ordinary telephone booths, about 200 feet apart, across the hall, and is under the supervision of the New York Telephone Company's corps of employés. The idea is one that was first exploited by Mr. Alexander Graham Bell about 15 years ago, and is extremely simple, but at the same time very interesting. A searchlight projector, taking a current of about 35 amperes from the 110-volt mains (through a resistance), furnishes the beam of light. Shunted around this is a specially constructed telephone transmitter, capable of withstanding large currents.

When this is spoken into its resistance is varied, the amount of current consumed in the arc and the energy of the projected beam being similarly affected. At the receiving end of the circuit is a large parabolic mirror, which receives the beam of light, or, rather, of radiant heat, from the arc projector and focuses it upon a small glass bulb containing some shreds of carbonized fibers similar to incandescent lamp filaments. To this bulb is connected an ordinary phonograph ear tube.

When the beam is concentrated upon the bulb the air in it is warmed through the absorption of heat by the carbonized fibers, and expands. With each variation of the intensity of the radiation which falls upon it is thus caused a corresponding change in the pressure of the air in the bulb, and in this way speech and other sounds are reproduced.

In the early experiments upon this apparatus a selenium cell, whose resistance varies with the energy of radiation impinging upon it, was used, in circuit with a battery and a telephone receiver. It was soon found, however, that a bulb of lamp-black, feathers, or even a blackened bulb containing nothing but air, was sufficiently sensitive to respond to the varying radiation. In Professor Bell's first work the beam was reflected to the receiving station from a plane mirror, against the back of which the sound waves to be transmitted were received. This caused the mirror to vibrate, becoming alternately concave and convex, and thus impressing upon the beam the desired variation.

In the apparatus at the exhibition the beam can be seen to flutter and alter when a note is sung into the transmitter. It may be remarked here that about a year ago Herr Herman Simon found that the arc itself can be used as a telephone transmitter or receiver, it being very sensitive to variations in the external air pressure, and also variable in size with variations of the feeding current.

Preserving Eggs by an Electrical Process.

An electrician in St. Paul, Minn., is credited by the newspapers with the discovery of a process for preserving eggs in an edible condition for a number of years. In preserving eggs by the new method, the egg is first placed in a vacuum chamber which draws the air from the interior. The eggs are then painted with a composition which renders them air-tight. After this they will be placed in barrels of water, and subjected to an electric current strong enough to destroy any germ life which may be present.

Chicago Edison Company to Increase Its Capital Stock.

The stockholders of the Chicago Edison Company have received notice that at the annual meeting, on June 12, the directors will submit a proposition to increase the capital stock not to exceed $1,000,000. This will amount to 20 per cent increase in the authorized capital, which is now $5,000,000, of which $4,975,000 has been issued.

Electrical Review

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News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week, although it is occasionally possible to get in matter received on Monday.

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ELECTRIC LIGHTING AS A FACTOR IN CIVILIZATION.

Some one has said that man's greatest invention is artificial lighting. When one looks back to the condition of primitive man he sees that the activity of a day was measured by the duration of daylight, for with the coming of darkness few of the crude arts of those savage days could be practiced. The progress of the race in civilization can almost be measured by the quality and quantity of artificial illumination. The candle and the lamp of early Greek days succeeded the smoking pine-knot torch, and with these inventions the progress of artificial illumination stopped for centuries. Improvements were made in oils as new materials were discovered and as the chemical arts advanced, and a few notable inventions in oil-burning lamps, such as Carcel's hollow wick, did something to ameliorate the darkness in which our forefathers passed their evenings; but it was not until the invention of gas lighting in the early part of the present century that any distinct advance was made.

It is curious to look back into the last century and conjure up a dim picture of our great grandparents—the family grouped in the evening about one tallow candle. Streets in those days, when not illuminated by a kindly moon, were simply left in darkness, a few sputtering lamps serving as lighthouses to guide the belated wayfarer rather than to dispel darkness. The brilliant era of electric lighting was inaugurated only about 20 years ago, and strange discoveries followed in the trail of its application, as has always been the case with each important invention.

It was ascertained that crime in the streets of cities was greatly decreased by sufficient lighting, and the remark has often been made that one arc light is equal to one policeman in the prevention of crime. Interiors, too, are so well lighted that work even of the finest kind progresses quite as well by night as by day. By the aid of the electric light the trammels of darkness have been burst, and when it is necessary to-day the work of the race goes on without reference to the natural alternations of darkness and daylight.

When it is considered that this amounts virtually to prolonging lifetime by adding useful hours at the expense of those other non-useful hours, it will be seen that in this direction electricity has worked a great and continually increasing good. It is without exception the largest material factor in the advance of civilization to-day.

NEWSPAPER SCIENCE.

In the New York *Herald* of last Sunday appears an illustrated article describing a machine just completed in Philadelphia, the home of the late lamented Keely, called the "Multiple Energizer Momentum Engine."

To quote the *Herald*, this surprising invention "has for its purpose the economizing of fuel by the ingenious utilization of nature's own power—the power which she has used for ages in the spinning of the globe upon its axis. This wondrous engine has been building, piece by piece, for a year, from plans that cost ten years of incessant toil, privation and patience, to say nothing of an expenditure of $90,000.

"The machine in question has for its dominant purpose the saving and utilization of momentum as power, the successful development of this heretofore lost force being brought into play by four driving wheels, which revolve independently on a shaft, just as a wagon wheel turns on its axle. Behind each wheel is a small steam engine, and when one wheel attains a given speed of 190 revolutions a minute the engine back of it ceases to use steam, and the wheel is ingeniously caught by a powerful clutch and made to whirl the shaft and its load.

"'The working wheel' drops its burden at the end of half a second, and the little five-horse-power engine in its rear has a second and a half in which to impart to the wheel, which is running unrestrainedly on the shaft, sufficient momentum to enable it to take up its work again, after each one of the other wheels has gone through the same process. It will be seen by this that all the diminutive steam engine is called upon to do is to whirl the flywheel it faces to a speed of 190 revolutions, rest half a second while the wheel takes hold to allow the momentum in the rim of the wheel to keep the machinery flying, and then get down to work again the instant the automatic clutch releases the flywheel."

It is hard to tell which is more pitiful—the fact that some deluded individual has wasted time and money in making this truly "wondrous engine," or that a newspaper of respectable standing should lend itself to the publication of a commendatory description of it. The daily press has much to answer for when it assists in deluding the public with this kind of misinformation. Young men of fair technical knowledge can be hired for so little in these days that it is inexcusable for a high class newspaper to be without at least a consulting technical expert. Reference to a person of competent knowledge would keep out of its columns such nonsense as that quoted above.

Philadelphia is to be congratulated upon its inventors. First we have Keely with his "duplex harmonic vibration etheric motor," and now comes the "multiple energizer momentum engine."

On May 27 our name contest, in which prizes are offered for satisfactory names for electric automobile vehicles, will be closed, and it is hoped that the names of the prize-winners can be announced in our next week's issue. So far the responses number about 400, and all sorts and kinds of names have been suggested. A surprising feature has been the number of ladies who have entered the contest. Suggestions have been received from places as remote as Caracas, Venezuela, while a considerable number have come from the Pacific coast.

It is stated that in Pittsburgh a trolley express service has been inaugurated. Large cars, having sliding doors in the sides, are run over the tracks of the various street railways in Pittsburgh and Allegheny City, and receive and deliver packages. At the suburban termini of the various lines the cars are met by electric automobile wagons, which carry the delivery several miles further into the country, wherever the condition of the roads permits.

This statement (which has only the unsupported authority of the daily press) is interesting, but incomplete. If express parcels can be carried into the country from the termini of suburban lines passengers can also be transported. But if the business in either kind of traffic warrants the expenditure for automobiles it would probably pay to build tracks and run the trolley cars further on them.

TWENTY-SECOND ELECTRIC LIGHT CONVENTION.

The National Electric Light Association Opens Its Annual Meeting in New York City.

REPORT OF FIRST DAY'S PROCEEDINGS —THE PROGRAMME FOR THE MEETING—PRESIDENT YOUNG'S ADDRESS—THE ATTENDANCE.

The twenty-second convention of the National Electric Light Association began its official sessions with the meeting of the executive committee, at 9 A. M. on May 23, in the secretary's office at the Murray Hill Hotel. In the convention hall at Madison Square Garden, at 11 o'clock, the meeting was called to order by President A. M. Young, who read his annual address. This was listened to with interest by a large and representative audience and was in full as follows:

In opening the Twenty-second Annual Convention of your association, I take great pleasure in welcoming you to the city of New York. I shall not attempt to enlarge on the beauties, advantages and wonders of this great city, because you all know it stands first among the cities of this country, and in many ways is the first city of the world. In electrical progress it has no equal. Within its limits are located 35 electric light stations, which furnish more than 1,000,000 incandescent lights and more than 30,000 arc lights, and at least 30,000 horse-power in electric motors. The capital invested for carrying on this great business is nearly $100,000,000. It may interest you to know that in 1897, in the city of Brooklyn alone there were 10 street railway companies having 678 miles of track, and a capitalization of $55,000,000. In that year these railway companies carried 223,180,504 people.

To-day every transit company in the Borough of Brooklyn is equipped or about to be equipped with electricity as its motive power, and the capitalization is $150,000,000, and over 236,680,010 people were carried by this vast system in 1898. Electricity, together with the inventive genius of honored members of this association only, has made this wonderful change possible.

An editorial in one of the prominent Brooklyn journals, speaking of the trolley, says: "Their power-houses are performing heart-like functions. They are now pumping the blood of the cities through distant arteries where the flow was sluggish—they carry life with them."

I think not only are the trolley companies entitled to a great credit for awakening the cities and towns all over this country to new life, but the electric light companies are also entitled to great credit in brightening up these cities and towns, showing the outside world they are alive.

The evolution in the electric light business has been wonderful. At the semi-annual convention of the association, held in New York, in August, 1885, the question of large and small engines and dynamos was discussed, and the late R. T. McDonald, of Fort Wayne, stated his experience at Peru, Ind. They were operating a large plant—something like 165 arc lights—with two large engines and two large boilers. After running them a short time, it was found no money could be made operating in this way. Small engines were substituted, after which the company earned good dividends.

In some of the large cities at the present time are being erected 6,000 horse-power units of engines and dynamos, and in most of the electric stations throughout the country large engines and direct-connected dynamos are the order of the day, and only by their use can the best economies be obtained.

The successful development of high-tension service is making it possible to utilize the water-powers that have been so long undeveloped. This service is revolutionizing the power question as to manufacturing business in many of our prominent manufacturing towns, where formerly steam had been altogether employed. As we are all much interested in the question of high-tension service, I think we shall learn much that will be helpful to us from the illustrated lectures which will be given at this session.

It has been the aim of your president to secure, for the benefit of the members of this association, papers by some of its prominent members on practical, every-day subjects, which are nearest the hearts of electric-light men, and which will help them in the operation of their own plants, and prove to them the value of this association. It will be pleasing for you all to know that never in the history of the National Electric Light Association has its membership been so great, and never so much interest shown in its success. I sincerely hope the members will be very prompt at all sessions and that as many as possible will be present to listen to the valuable papers herein referred to.

I now declare the Twenty-second Convention of the National Electric Light Association opened and ready for the transaction of business.

Following this, Mr. W. S. Barstow, of Brooklyn, N. Y., read a very interesting paper, entitled "A Local Transmission System—Development and Operation."

The discussion was opened by Mr. Ferguson, of the Chicago Edison Company, and was participated in by Messrs. T. H. Creden, F. W. Walker, C. W. Rice, H. A. Wagner and Von Pool. Many interesting points concerning the expediency of electric driving for station auxiliaries and the cost of such applications were brought out.

It was expected that the Committee on Standard Rules for Electrical Construction and Operation would make its report during the morning session, but on account of the absence of Capt. William Brophy the report was held over.

The afternoon session was called to order at two o'clock, and a paper, entitled "Rotary Transformers and Storage Batteries—As Related to Long-Distance Transmission," was read by Prof. William Lispenard Robb, of Hartford, Ct.

The discussion was opened by Mr. E. A. Leslie, after which Mr. James I. Ayer made some remarks. In response to a question by Mr. H. A. Wagner, Professor Robb discussed the question of balancing the load on a three-wire system fed by rotaries. Replying to a question by Mr. Ayer, he described the system of alternating-current series arc lamps in operation at Hartford. There are 630 lamps operated from seven constant-current transformers. Only 400 watts per lamp are absorbed. Mr. Wagner described a system of 2,600 arc lights worked in this way in St. Louis. After some further discussion, the topic of "Transformer Tests" was entered upon.

Prof. W. E. Goldsborough, of Perdue University, opened the discussion with a long account of a series of tests made on five 5-kilowatt transformers of various commercial makes, to determine their efficiency, core and copper losses, and "aging loss," as well as a number of experiments on oil used in transformer insulation. His remarks were illustrated by numerous tables and diagrams.

Beginning the discussion, Mr. E. A. Leslie spoke of early transformers and the troubles encountered with these instruments in former years. He hazarded the opinion that five years is the average life of a transformer. This opinion was combated by Mr. Wagner and Professor Goldsborough. Professor Robb brought out the importance of working transformers on the class of loads for which they are intended. The discussion then turned upon the question of aging, and became general, Professors Robb and Goldsborough and Messrs. Ayer, Perkins, Wagner and others taking part.

At the conclusion of the discussion a vote of thanks was tendered to Messrs. Barstow, Robb and Goldsborough for their papers presented during the day, and the association went into executive session, soon after adjourning to meet at 10 o'clock Wednesday morning.

The programme for the balance of the week is as follows:

Wednesday, May 24, 1899, morning session, 10 o'clock—Paper, Herbert A. Wagner, St. Louis, Mo., "Single-Phase Distribution." Paper, Louis A. Ferguson, Chicago, Ill., "Underground Electrical Construction."

Afternoon session, 2.30 o'clock—Paper, E. A. Leslie, New York city, "Some Notes on Underground Distribution of Two-Phase Current in New York City." Paper, W. L. R. Emmet, Schenectady, N. Y., "Means of Affording Safety in Electrical Distribution." Report, Committee on Standard Candle-Power of Incandescent Lamps, Dr. Louis Bell, chairman. Report, Committee on Legislation Regarding Theft of Electric Current, E. A. Armstrong, chairman.

Evening session, 8 o'clock, Madison Square Garden—Lecture, Calvin W. Rice, New York, N. Y., "The Development of High-Tension Service." Illustrated by stereopticon.

Thursday, May 25, 1899, morning session, 10 o'clock — Paper, H. M. Atkinson, Atlanta, Ga., "Alternating-Current Generation and Distribution —Changes Contemplated in Atlanta." Report, Committee on Amendments to Freight Classification, James I. Ayer, chairman. Report, Committee on Legislative Policy, Samuel Insull, chairman.

Afternoon session, 2.30 o'clock—Report, Committee on Standard Specifications for Electrical Apparatus, Paul Spencer, chairman. Report, Committee on Finance, John H. Seely, chairman. Executive session — Reports, secretary and treasurer; executive committee. Election of officers.

At 3.30 on Monday afternoon a western delegation arrived in New York city over the West Shore Railroad. They were met by a committee from the New York members of the National Electric Light Association, and escorted to headquarters at the Murray Hill Hotel. The western party included Mr. W. W. Low, accompanied by Mrs. Low, and Messrs. W. M. Smith, M. E. Baird, James Wolf, Ed. Grier, W. Forman Collins, Herbert Wagner, Franklin Overbaugh, A. M. Barron, C. E. Kammeyer, Harold Almert, W. R. C. Smith, George White, Patten, Phillips and Thomas Mercein, secretary of the Northwestern Electrical Association.

An important meeting of the Entertainment Committee was held at the Murray Hill Hotel on Monday evening, at which final arrangements for the electric automobile ride and steamboat excursion for the benefit of the ladies attending the convention were decided upon.

At seven o'clock on Tuesday morning the Boston delegation arrived, having come on a special car from Boston to Fall River and thence on the steamer "Priscilla" to New York, where two tally-ho coaches met the party. There were 58 ladies and gentlemen in the delegation, which was in charge of Mr. R. F. Ross. Among others were Messrs. James I. Ayer, G. B. Neal and daughter, F. Elwood Smith and wife, Norman Marshall and wife, Orrin Smith, Jr., and wife, George C. Wight and wife, Sears B. Condit, Jr., H. B. Moore, T. H. Bibber, D. W. Dunn and E. F. Dwyer.

Mr. Henry Hine, general manager of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., visited New York city last week.

RECENT EXPERIMENTS WITH THE OSCILLOGRAPH.

BY PROF. ANDRÉ BLONDEL.*

In 1893 I showed the process of construction and the theory of a galvanometer for extremely rapid indications, to which there has been given to-day and generally adopted the name of oscillograph, and which permits of the determination by a direct and fairly exact observation of the periodic curves of alternating currents. As I announced at that time, these machines appeared to me to be destined to play in the study of alternating currents a role similar to that of the indicator with reference to the steam engine. The progress made since that time by other experimentalists and by myself in the construction of the two principal types of this apparatus sustain me in the belief that this prediction is not far from being realized. This recent progress is what I propose to describe, after having rapidly recounted the beginnings of the oscillograph.

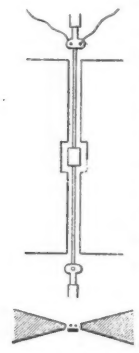


FIG. 1.—THE BIFILAR OSCILLOGRAPH.

To obtain the desired result, it is, of course, necessary that the moving parts of the instrument shall oscillate sensibly in accordance with the law of variation of the current acting upon it. Considering the subject with reference to the general equation of damped galvanometers:

$$K\frac{d^2\theta}{dt^2} + A\frac{d\theta}{dt} + C\theta = G\,I$$

where K is the moment of inertia, A the coefficient of damping, C the torsion couple and G the galvanometric constant, it will be seen that the two first terms must be made negligible with reference to the third, as will be explained below.

Supposing this result obtained, then, by combining the deviations with a movement in a vertical plane by the aid of well understood methods of optical composition, the oscillating functions of the current may be shown as a curve.

This problem was not entirely new in 1893, for already various instruments had been suggested for its solution in the case of comparatively slow oscillation; viz., the galvanometers of Colley, d'Arsonval, Arnoux, Eric Gérard, the telephone of Elihu Thomson, Fröhlich, etc. But none of them fulfilled the conditions necessary (and these had never been well elucidated) for the study of alternating currents of high frequency.

According to the theory five conditions must be satisfied by these instruments, the two first of a general variety applicable to all kinds of indicators, the others having special reference to electric oscillographs. Practical experience has indicated still a sixth.

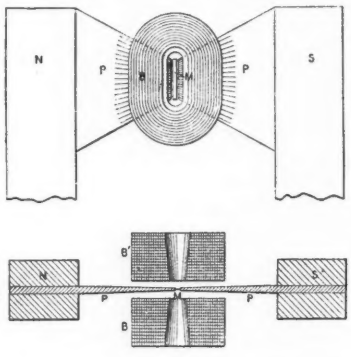


FIG. 2.—THE SOFT IRON OSCILLOGRAPH.

1. The instrument should have a period of oscillation exceedingly short, with reference to that of the electrical vibration For example, for ordinary alternating currents for a frequency of from say 40 to 100 periods per second, a good oscillograph should vibrate with a frequency at least 50 times greater; that is to say, of not less than 5,000 periods a second.

2. The damping should be adjusted as nearly as possible to an aperiodic value whenever the electric oscillations are not very continuous, or when abrupt variations are not suppressed by some correcting mechanism. I have attained this end by placing the moving parts in viscous liquids empirically chosen. In my first apparatus a bath of spirits of turpentine and syrupy Canada balsam was the only thing that seemed to suit the conditions, but this mixture is not convenient, because it absorbs much of the actinic radiation of the spectrum and undergoes changes in viscosity with changes of temperature. In later types I have been able to attain much better results with castor oil or vaseline oil enclosed in a small cavity. These substances have the great advantage of being perfectly transparent and of also acting as a lubricant upon the pivots of the moving parts of the apparatus. Their viscosity is much less variable and it is easy to regulate their temperature either by a circulation of water in the pole-pieces of the apparatus or by heating it by the electric current.

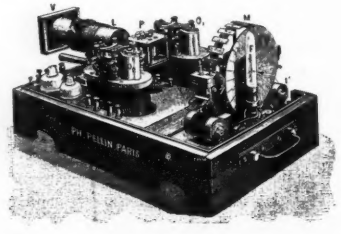


FIG. 3.—THE DOUBLE OSCILLOGRAPH.

3. The self induction of the apparatus should be as small as possible in order that it shall not alter the law of variation in the currents measured.

4 The phenomena of hysteresis and Foucault currents should be entirely suppressed in the apparatus.

5 The sensitiveness of the apparatus should be high, which, of course, requires the employment of excessively small moving parts.

6. Finally, the illumination of the spot of light used in making the records should be exceedingly brilliant, to allow easy seeing and rapid photographing of the curves given out by the apparatus.

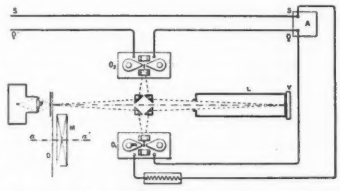


FIG. 4.—DIAGRAMMATIC PLAN OF DOUBLE OSCILLOGRAPH.

Conditions one, five and six are more or less opposed, and it is progress in connection with them which I wish to describe.

At the commencement of the work I described two satisfactory types of indicating apparatus of different sensibilities, the bifilar oscillograph and the soft-iron oscillograph. All that have been made since are of these two types, but the first appears to be better, and, consequently, merits a more extended description.

The bifilar oscillograph is a new form of galvanometer, derived from the moving coil instrument by the following considerations:

The coil of a d'Arsonval galvanometer, to properly operate for this work, should have dimensions much smaller than those worked out by MM. Gérard and Abraham, and its construction would, therefore, be very difficult. Both the inertia of the coil and its sensitiveness are proportional to the number of turns. Consequently, I have not felt it necessary to use more than two. From this I have concluded that the simplest solution consisted in suppressing the coil altogether and replacing it by a simple bifilar arrangement, formed by two parallel wires very close together and traversed by the current to be studied, carrying upon their middle part a small mirror. This arrangement was placed between the two poles of an electro-magnet, which were brought as close as possible to it, as is shown in Fig. 1. This gives an elevation and plan view of the apparatus. The advantages of this arrangement are the simplicity of the suspension, the absence of all external vibration, the low self-induction and the high intensity possible to give to a magnetic field of this character, which makes the instrument very sensitive. It was left undeveloped for several years because of difficulties which I encountered in fastening the mirror to the two wires of the suspension in any permanent way.

The soft-iron oscillograph is shown in plan and elevation in Fig. 2. In this apparatus a very small bar of soft iron carrying a mirror was suspended in a very intense magnetic field, produced either by a permanent magnet or a powerful electro magnet. The currents to be observed pass through two coils placed on each side of the pole-pieces and producing an oscillating magnetic field perpendicular to that of the magnet. In order to reduce the moment of inertia, the bar is made very narrow and small in the direction of its plane of oscillation. This instrument is derived, as one naturally sees, from the Deprez galvanometer. In order to avoid Foucault currents, the polar pieces are either slotted with saw cuts or made of an assemblage of sheets of soft iron. On account of the strong attractions which the movable part of this apparatus suffers, I have found it necessary to hold it in place by pivots. It can also be held in place either by a flat bronze or aluminum spring or a strip of metal stretched vertically, in which case the sensitiveness is diminished somewhat, while the frequency of the period of free vibration is increased.

While this machine is simpler and in some respects less fragile than the bifilar, and also allows the use of a larger mirror, it presents considerably more self-induction to the circuit, and is much less sensitive. In the first apparatus of this sort, which had a period of vibration of about 1,500 per second, the iron bar was one-sixth inch high, one-fiftieth inch thick and

*Translated in abstract from *L'Industrie Électrique.*

pivoted upon sewing needles. It was damped in a bath of Canada balsam. Messrs. Hotchkiss, Millis and MacKittrick, in America, brought this instrument to a high point of perfection regarding the rapidity of its oscillations by greatly reducing the size of the moving bar which they made one-twenty-fifth inch wide, one-twelfth to one-twenty-fifth inch high,

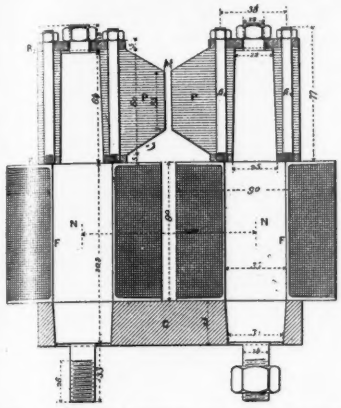


FIG. 5.—CROSS SECTION OF OSCILLOGRAPH FIELD MAGNETS.

and one two-hundred-and-fiftieth inch thick. They also reduced the magnetic strain upon the moving parts so that they could be suspended by a cocoon fiber. In this way they managed to obtain a frequency as high as 3,000 vibrations per second.

Unfortunately this progress towards sensitiveness was only realized at the expense of the mirror surface, which became so small as to be scarcely sufficient for photographic purposes, and entirely too small for the industrial employment of a direct vision instrument constructed in this manner. Furthermore, it became necessary to do away with the use of the damping liquid, of which the effect is quite indispensable for the production of exact curves.

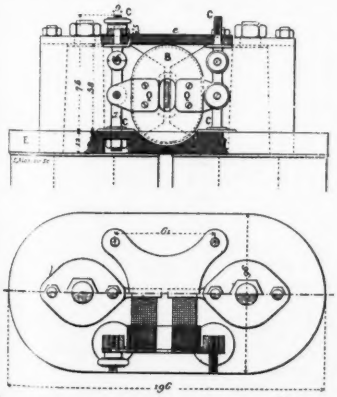


FIG. 6.—PLAN AND ELEVATION OF MOVING PARTS OF THE OSCILLOGRAPH.

Taking up the subject again in 1896, I was led to preserve the pivoting arrangement, the use of a large surface mirror and liquid damping, while simplifying and perfecting the construction of the apparatus. The machine, which was made and presented at the 1897 exhibition of the Société de Physique, had a period of vibration of between 5,000 and 6,000 oscillations per second, and gave results in direct-vision study of curves of commercial currents. The portable apparatus, which is illustrated in Fig. 3, was for the purpose of studying current waves under commercial conditions, not necessarily in a laboratory, the instrument having been designed to be used in a workshop or lighting station. Sensitiveness has been somewhat sacrificed in its design for other desirable qualities, such as a brilliant illumination of the moving spot of light. The apparatus is double, and gives at the same time curves of voltage and of current in similar phases in the same field of view or upon the same photographic plate. Fig. 4 is a sketch plan of the apparatus in which O_1 and O_2 are two oscillographs of the soft iron pattern, wound respectively with high and low resistance for the measurement of voltage and current. A system of four prisms in the center of the apparatus throws the double image upon the eyepiece or screen at V, while a revolving disk D, driven by a synchronous motor M, adds the necessary component of motion in a direction perpendicular to that given the mirrors of the oscillographs by the action of the electric currents. Fig. 5 shows a vertical cross-section of the powerful electromagnet, which forms the field of the oscillograph, while Fig. 6 shows in plan and elevation the arrangement of the cross-magnetizing coils upon the top of the apparatus. These are wound respectively with strip copper and fine wire, the one carrying the main current to be measured, while the other gives indications of the variation of voltage. The illustrations render a further description of this apparatus unnecessary, as they clearly show the method of construction. The most delicate part of the oscillograph is naturally the moving needle; Fig. 7 shows an elevation, plan and cross section of this. It is formed of a thin strip of soft iron one-fiftieth inch thick, one-twenty-fifth inch wide and five-eighths inch high, upon

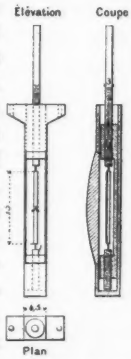


FIG. 7.—THE OSCILLOGRAPH NEEDLE.

which is cemented a mirror of very thin glass, silvered on the surface. At the ends of the little strip it is turned down to small points, which rest in ruby watch jewels carried in the ends of the threaded rods shown in the illustration. These are screwed into a little cell, carved of ivory, about one-twelfth inch in diameter and set in a little box of the same material, one-fifth inch square, which is filled with the damping liquid. The whole apparatus is mounted between the polar projections of the electro-magnet shown in Figs. 5 and 6. In front of this box is a fixed lens of about 19 inches focal length, which is used to form images of the slit through which light is projected upon the mirror.

The arrangement of prisms shown in Fig. 4 is used to superpose the images of the light spots of the two oscillographs, the voltmeter and ampere-meter respectively, the whole apparatus being mounted upon a wooden baseboard. The source of light is an arc or incandescent lamp mounted in the box F (Fig. 4), which is furnished with a condensing lens. Fig. 8 shows an arrangement by which the movement at right angles is given to the indicating spot. A thin disk having radial slits is worked by a synchronous motor. Through this the light passes from the box F through a fixed slit which is vertical, falls upon the mirror of the oscillograph and is reflected back to the screen. Naturally if the mirror stands still, a vertical streak of light will be formed upon the screen or photographic plate, but if the mirror oscillates under the influence of an alternating-current wave, the combination of the two movements results in curves such as are shown in Figs. 9 and 10. Observations are taken either by direct vision upon a ground glass screen, or the curves may be photographed by placing a sensitive plate at V (Fig. 4). The curves shown in Fig 9 represent the voltage and current curves in a circuit containing an alternating-current arc between two similar solid carbons. Fig. 10 shows similar curves, marked respectfully U and I, for voltage and current for a circuit containing an arc between cored carbons.

[In the ELECTRICAL REVIEW for May 3 there was reproduced a series of curves taken by Professor Blondel with the oscillograph, showing the current and voltage variation in a circuit containing a Wehnelt interrupter and an inductance.—ED.]

The wages of the Indianapolis, Ind., employés of the Central Union Telephone Company have been increased, the advance in some cases being as high as 20 per cent.

Another Bunch of Electric Vehicle Companies Incorporated.

Seventeen automobile companies connected with the Whitney-Rice-Moloney Electric Vehicle Transportation Company were incorporated at Trenton, N. J., on May 19. The capital stock of 16 of them is $100,000 each, and the capital stock

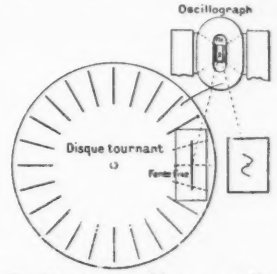


FIG. 8.—DIAGRAM OF METHOD OF OPTICAL COMPOSITION.

of one is $6,000,000. These are all operating companies to be added to those already established in several States of the Union. The last named is for operation in the District of Columbia. The 16 other companies will be distributed one each in Tennessee, Georgia, Ohio, Kentucky, New Jersey, Louisiana, Delaware,

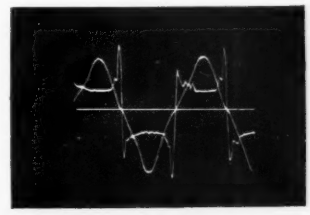


FIG. 9.—OSCILLOGRAPH CURVES.

California, Michigan, Minnesota, Iowa, Maryland, Wisconsin, Indiana, Missouri and Virginia. It is said that a company will be located in every State and Territory of the Union, and that ultimately the enterprise will be extended to Canada, Mexico, Cuba, South America and Europe.

The deadly long-range press telegram says: A nineteen-year-old ap-

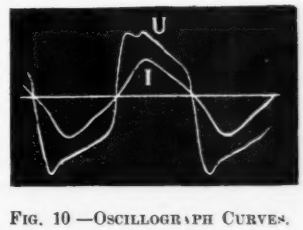


FIG. 10.—OSCILLOGRAPH CURVES.

prentice named Newman, of the Whitehead Torpedo Works, in England, has invented a deadly, noiseless, smokeless electrical gun, for which he is said to have refused $375,000 offered by the English Admiralty. The gun discharges explosives at long range and with great accuracy.

A LOCAL TRANSMISSION SYSTEM—DEVELOPMENT AND OPERATION.

BY W. S. BARSTOW.*

The electrical fraternity has long since listened to accounts of developments in power transmissions, which, step by step, are gradually becoming amalgamated with the large local distributing systems, furnishing a grand public demonstration of the commercial progress of the science.

It is not the purpose to enter here into any new theories of complicated machine design, but to state the actual commercial experience of a large transmission and distributing system recently installed. As the Brooklyn three-phase transmission and substation distributing system has already been fully described, it is unnecessary here to enter upon any further details, but it may be well to glance for a moment at the conditions which promoted the adoption and installation of such a system.

Brooklyn some 50 years ago included three square miles of territory, of which the present Brooklyn Bridge terminal was the center. To the north grew up the smaller towns of Williamsburg and Greenpoint; to the east, the settlement of East New York, and to the south, the towns of Canarsie, Flatbush, Gravesend, Bensonhurst, New Utrecht and Bay Ridge. Each town had its own little business center, its own town hall, and, in several cases, its own banks, theaters, etc. About 40 years ago the limits of the city of Brooklyn were extended to include Williamsburg, the city then covering some 16 square miles, in which there were located two distinct commercial centers, about two miles apart, and separated by farm lands and unsettled country. About six years ago the boundaries of the city were extended to take in all Kings County towns. The lighting companies in Brooklyn in those days were four in number, but a gradual consolidation soon placed one company in possession of all the territorial rights—overhead and underground—of the city, which now covers about 120 square miles.

In 1895 the Edison company decided to occupy at once with distributing systems of some kind all the best portions of the territory of the greater city. Either the establishing of eight small steam stations or the installation of some system that could furnish energy for any class of distributing system which might be installed in any of the localities, at the same time rendering more efficient the existing plants. Under these conditions there was no hesitation in at once outlining a plan which would provide for a large and independently located transmission distributing system.

The plan as originally outlined in 1896, and as finally completed in 1897, provided for the use of a three-phase, 25-cycle, 6,600-volt system; three-phase because its use was for transmission purposes only; 25-cycle because of the ease at this frequency of station operation, transmission and transformation, and a pressure of 6,600 volts because this was sufficient, with the price of copper at 18 cents, to reach economically all parts of the greater city and suburbs; should it in the future ever become necessary to extend beyond this 12-mile limit, the pressure could be increased by transformers placed out at the city lines for overhead transmission to other territory. Such a system as this meant considerable pioneering work from its very start, for although there were several plants in Europe and the West constructed on almost similar lines, the local conditions were so different that many new departures were necessary. For example, almost all of the high-tension plants in 1896 generated at a low potential and transformed, while in the Brooklyn plant the line pressure is secured directly from the machines, thus necessitating a switchboard outfit for handling the 6,600 volts, not on a straightaway transmission, but on a regular multifeeder distributing system.

The main station, located on the water front at Bay Ridge, is called the Union station, because it generates a current which unites all systems hitherto separately operated. From this point high-tension feeders, the majority under ground, extend to 10 substations, where the energy is received, transformed and distributed as follows:

Substation "A" distributes energy for 1,700 high-tension, direct-current, series arc lamps on an overhead system.

Substation "B," as well as substation "C," distributes two-phase, 60-cycle current, up to a capacity of 200 kilowatts, to an overhead system.

Substation "D" distributes two-phase 60-cycle, alternating current of about 200-kilowatt capacity to an underground distributing system. This underground system is composed of Edison three-wire tube, with block transformers in manholes.

Substation "E" distributes high-tension direct current for 300 series arc lamps, low-tension direct current on three-wire system to a capacity of 800 kilowatts, and high-tension alternating current, two-phase, 60-cycle, of a capacity of 200 kilowatts, to overhead distributing systems.

Substation "F" distributes 400 kilowatts of direct current to an underground Edison three-wire system.

Substation "G" distributes 200 kilowatts of direct current to an Edison overhead system.

"Substation "H" distributes 200 kilowatts of direct current to an Edison overhead system, besides 250 kilowatts to 500-volt, direct-current power system along water front.

(To be continued.)

* A paper read before the National Electric Light Association, New York, May 23, 1899.

Erie Telephone Company Buys the Wisconsin Telephone Company.

The formal transfer of the property of the Wisconsin Telephone Company, whose headquarters are at Milwaukee, Wis., to the Erie Telephone and Telegraph Company, was made last week. The former officers resigned their positions and new officers were elected as follows: Charles J. Glidden, president of the Erie Telegraph and Telephone Company, president; James P. McKinstry, of Cleveland, Ohio, vice-president; Charles A. Grant, of Lowell, Mass., treasurer; Geo. B. Perham, of Tyngsboro, Mass., secretary. Mr. Glidden succeeds the Hon. Henry C. Payne as president, and Mr. McKinstry takes the place of Frank G. Bigelow, as vice-president. Messrs. Payne and Bigelow will remain on the board of directors. Mr. D. E. Roberts, of Milwaukee, was elected local treasurer and auditor of the company, and Mr. John D. McLeod will continue in the capacity of general manager. The combined companies of which Mr. Glidden is president, are now serving 77,000 subscribers, and the number is increasing at the rate of 4,000 monthly. By January 1, Mr. Glidden expects to have 100,000 subscribers in the eight states controlled by his companies.

WESTINGHOUSE VERSUS GENERAL ELECTRIC.

The demurrer filed by the defendant in the suit instituted by the Westinghouse Electric and Manufacturing Company, to enjoin the General Electric Company from delivering multiphase apparatus, news of which was published in the ELECTRICAL REVIEW of March 22, 1899, was sustained at Utica, N. Y., on May 22, in favor of the General Electric Company. Mr. F. P. Fish, attorney for the General Electric Company, said to a representative of the ELECTRICAL REVIEW: "Judge Coxe's decision practically says that the plaintiff failed to state its case."

Mr. Samuel Insull Married.

Mr. Samuel Insull, president of the Chicago Edison Company, was quietly married in New York city on May 23 to Miss Gladys Wallis, the well known actress.

Mr. John H. Cahill, secretary of the New York Telephone Company, accompanied by Mrs. Cahill, left, on May 17, on the steamship "St. Paul" for a brief holiday in England and France.

The Proposed Rubber-Covered Wire Combination.

The rubber-covered wire combination seems to be approaching a completion, and it is generally believed that the probabilities of a successful termination are greater at the present moment than ever before. The projectors, at the date of going to press of the ELECTRICAL REVIEW, have options on all the rubber-covered wire manufacturing plants, with the exception of the following: That of the Simplex Electrical Company, Boston; the John A. Roebling's Sons Company, Trenton; the Washburn & Moen Manufacturing Company, Worcester, and the W. R. Brixey plant at Seymour, Ct., the latter manufacturing the "Kerite" wire.

A representative of the ELECTRICAL REVIEW was told by Mr. E. E. Jackson, Jr., of the firm of Perkins & Jackson, attorneys, who are the organizers of the consolidation and represent a coterie of capitalists, including Mr. Charles R. Flint and prominent Boston gentlemen, that these options expired on June 1, but that the arrangement permitted them to have a three months' renewal.

The representative asked Mr. Jackson, who deprecated any newspaper publicity for the matter, as to the accuracy of the information.

Mr. Jackson replied: "The facts which you have are substantially correct. We have options on all these companies excepting four, and it is probable that we shall be able to make a definite announcement during the next week." He added that the books of all these companies had been audited, the properties appraised, and that the only possible delay was the high valuation of certain of these plants, and that it remained for the projectors to decide whether these high valuations were sufficiently serious to delay the consummation.

At a meeting of the capitalists interested in the deal, including Charles R. Flint, held on Monday of this week, it was decided not to renew the options expiring on June 1. This means that the combination will be effected within a week, or postponed indefinitely.

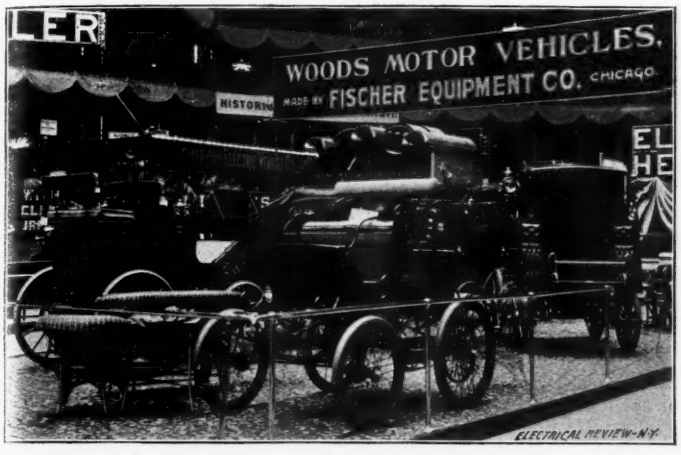
A General Electric Dividend.

At a meeting of the directors of the General Electric Company, held on May 22, a dividend of one and one-half per cent was declared upon the reorganized common stock, payable July 15. The directors expect to declare quarterly dividends at this rate hereafter. Books for the dividend close June 30 and reopen July 17.

SOME SPECIAL FEATURES AT THE NEW YORK ELECTRICAL EXHIBITION.

(Continued from page 325.)

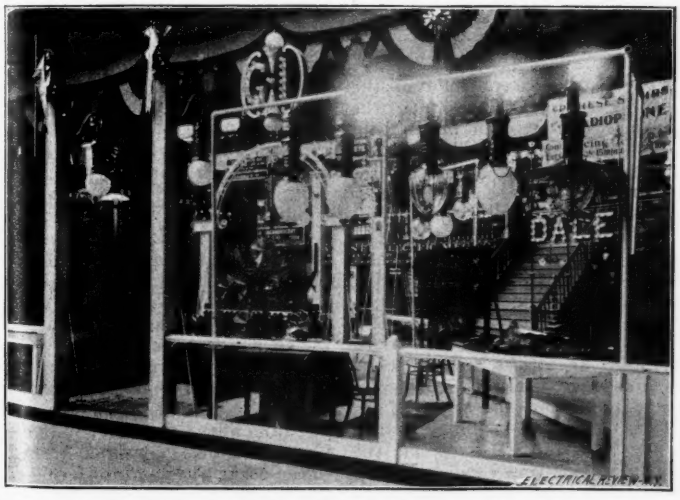
the stimulus of the rapid and complete interruptions due to this instrument the coil becomes the center of a torrent of powerful sparks eight or nine inches long. The effects when



THE NEW YORK ELECTRICAL EXHIBITION—EXHIBIT OF THE FISCHER EQUIPMENT COMPANY.

condensers are connected are truly magnificent.

Upstairs in the main hall stands a handsome automobile, built by the Riker Electric Motor Company, which is being voted to the most popular actress. Purchasers of tickets of admission are each given coupons, and up to this time the voting is a fairly

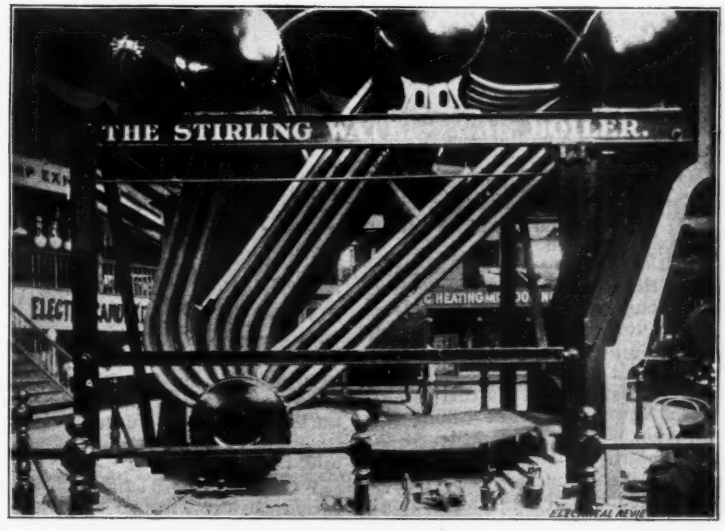


THE NEW YORK ELECTRICAL EXHIBITION—EXHIBIT OF THE GENERAL INCANDESCENT ARC LIGHT COMPANY.

even race between Miss Maude Adams and Mrs. Leslie Carter.

On Friday evening, May 19, a number of consular representatives of foreign countries and manufacturers attended the exhibition. Shortly after 9 o'clock the visitors were escorted through the exhibition by a committee of the exhibitors, of which Mr. H. L. Shippy was chairman. Many new inventions intended for the foreign market were displayed. Among the countries represented by their Consuls-General were: Great Britain, Percy Sanderson; France, E. Bruwaert; Germany, August Feigel; Belgium, Charles Mali; Austria-Hungary, Franz Stocklinger; Italy, G. Branchi; Argentine Republic, Carlos Rohl; Norway and Sweden, Christopher Ravn; Bolivia, Enrique Wulff; Netherlands, John R. Planton; Chili, Frederick A. Beelen; Portugal, Luiz Taveira; China, Chung Pao Hsi; Russia, W. Teplow; Colombia, Climaco Calderon; Siam, I. T. Smith; Costa Rica, C. R. Flint; Ecuador, Miguel Valverde; Greece, Demetrius N. Botassi; Hayti, J. Nicolas; Guatemala, Dr. Joaquin Yela; Japan, S. Uchida; Corea, Everett Frazar; Mexico, Juan N. Navarro; Venezuela, Antonio E. Delfino; Paraguay, Felix Aucaigne; Liberia, Frederick W. Yates; Monaco, Henri Moet; Turkey, Mundji Bey Fikri; Uruguay, T. A. Eddy; Persia, H. Ruthven Pratt.

Among the exhibits which have been highly admired is that of the General Incandescent Arc Light Company, of New York city, an illustration of which is shown herewith. This company is making a very handsome display of Paragon electric fans of various styles, direct-current and alternating arc lamps, enclosed arcs, standard knife switches, quick-break railway switches, Wright discount meters and Hoyt meters, as well as a large number of "G. I." specialties of all kinds. The exhibit is one of the handsomest in the hall, but its size and the great number of objects com-



THE NEW YORK ELECTRICAL EXHIBITION—EXHIBIT OF THE STIRLING COMPANY.

prised in it render it difficult to do it justice in the small illustration herewith.

The Stirling water tube boiler is exhibited by Mr. B. M. Barr, the New York agent. The boiler is not shown in operation, but partly mounted, as the illustration well shows, and gives an admirable idea of the circulation of both fire and water in boilers of this class. A number of valves and other steam specialties are shown in the same exhibit.

The latest of the automobile exhibits to be installed was that of the Woods motor vehicles, made by the Fischer Equipment Company, Chicago. Six handsome vehicles are shown—a runabout, a break, a four-seat trap, a Stanhope, a Hansom cab and a coach-pattern delivery wagon. All of these vehicles are of the two-motor type, using a four-pole motor geared to each rear wheel, the steering being accomplished by shifting the front wheels. A noticeable feature about these vehicles is the lightness of their design, one of the runabouts weighing only 900 pounds complete, yet having sufficient battery capacity for a 20-mile run on average roads. The motors are geared to the wheels through raw-hide pinions and cut-steel countergear, and are of a four-pole completely enclosed form. On the shaft of each motor is a disk, around which runs a strap brake, and this is worked by the controller lever. The normal stand still position of the controller is vertical. For speeds ahead this is thrown forward through three notches. Pulling it back past the stand-still point sets the brakes, and it is thus seen that the brakes can not be put on while the current is on the motor, or vice versa. The delivery wagon weighs, complete, 2,300 pounds. Two vehicles of this type which were recently delivered to a large department store were loaded with 1,000 pounds of bricks each, and sent on a trial run over city streets. They each made 33 miles on one charge. The running gear of all these vehicles is provided with pin-joints to connect with the forward axle, thus allowing the necessary vertical play to the wheels without throwing any strain upon the mechanism. Wooden wheels with cushion rubber tires are used on all of them, the manufacturers considering this form of wheel and tire to be superior to the bicycle type wheel with fat pneumatic tires now in general use on automobiles. The exhibit is in charge of Mr. L. G. Nilson, the electrician of the company, with several assistants.

SIMULTANEOUS TELEPHONY AND TELEGRAPHY.*

BY CHARLES SELDEN.

In the Fall of 1885 or the Spring of 1886 I was assigned to the duties of experimentation upon the line of simultaneously telephoning and telegraphing by the method invented and patented by Francois Van Rysselberghe, of Belgium, an electrician and scientist, who held a professorship in the University of Ghent and was attached to the Belgian Court. He was a gentleman of rare attainments and most genial qualities, with whom it was a pleasure to labor.

He brought to this country, for the purpose of the sale of the same, the system which he invented.

So far as the Patent Office records show, he was the first person to intelligently and thoroughly grasp the idea of the simultaneous use of the wire for telegraphic and telephonic purposes, and to construct a system therefor.

A short time prior to the filing of his patent in this country, Professor Rosebrugh, of Canada, had filed and patented a system for the duplexing of telephones, as I recollect it now, and it appeared that his patent admitted of reaching the same or similar results as did that of Professor Van Rysselberghe, although that was not shown to be clearly and apparently the point for which he had invented the system.

Without saying or implying the least thing that would be taken as detracting from the efforts of Professor Rosebrugh, of Canada, and with the desire to be entirely fair, I feel it but right to say that my impression has always been that to Professor Van Rysselberghe belongs the first honor of the invention of the "composite circuit," for the reason that, if his patent papers be read, it will be found that his prime and only object was this purpose, while in Professor Rosebrugh's patent it is hard to determine that he cared or expected to reach anything but the duplexing of a telephone circuit, so as to make one wire as good as two.

With this brief outline of the inception of the system, I will proceed to detail such experiences as we have had on the lines of the Baltimore & Ohio Railroad and Telegraph Company with the Van Rysselberghe system.

In order to operate simultaneously and thus form what is now known as a "composite" circuit, it was necessary that the abruptness of the wave caused by the Morse signal should be reduced upon the lines to be used simultaneously for telephone purposes, so that, although the waves might traverse the windings of the telephone, the diaphragm would move so slowly as to be at a rate which the ear would not discern, in contradistinction to the more acute or rapid vibrations or waves caused by the transmission of speech through the means of a transmitter.

For the purpose of arriving at this condition, instruments termed "graduators" were used. These graduators consisted of helices wound up to a given amount of resistance and having a keeper attached to the two poles, thus forming a "closed magnetic circuit" within the device. And, in addition to these, electrical condensers were employed in the manner to be hereafter shown.

Every wire traversing the line of poles was "graduated," and at points where circuits ended for the purpose of taking battery, they were again "graduated;" and if, for instance, a wire from another line should traverse the same set of poles for a distance, then that line at the point of joining and leaving the said set of poles was graduated either at those points or at its terminals. Having thus graduated, or, in other words, taken away from the Morse wave its acuteness, it was then feasible to take in pair or in set of pairs and use the wires simultaneously for telephonic purposes.

This was done by connecting from one wire to one terminal of a condenser; from the other terminal of the condenser a wire was extended to a terminal of the telephone apparatus, and from the other terminal of the telephonic apparatus a wire was extended and connected to the other main wire, which became the second wire of the pair.

This having been accomplished, connection was made at each terminal, providing a path for the telephonic circuits, and forming, practically, for its use a metallic circuit starting, say, from point A, on wire 1, through condensers and telephonic apparatus to wire 2; by wire 2 to terminal station B; from wire 2 to one terminal of a condenser; from the other terminal to the telephonic apparatus terminal, and from that to wire 1, thence by wire 1 back to station A.

Where any intermediate offices occurred on any wires so used, it was necessary to arrange a path for telephonic circuits, so that when the keys were open at such stations, there would still be afforded a route for the telephonic circuit, and this was gotten by the connection of a condenser around the instruments at said station, which not only bridged over the open keys, but afforded a non-magnetic path around the relay at such station; thus avoiding retardation in the telephonic circuits, which otherwise would have occurred.

Our service at that time contained few or no copper wires, and we were limited, therefore, to the use of iron for the purpose of our experiments.

The experiments were perfectly successful, and commercial conversation was carried on between Baltimore and Cumberland, Md., a distance, as the wires run, of about 195 miles.

When we reached Grafton, W. Va., and made experiments from that point (which added to the distance so that it became 300 miles), the talk ceased to be "commercial." It was possible and successful to a certain extent, but that was all.

Proceeding further to Parkersburg, W. V., now a distance of 405 miles, the difficulties became so much enhanced as to render the talk unintelligible.

The fact, however, of non commercial talk from Grafton or Parkersburg was not due to any weakness or fault of the system as devised by Professor Van Rysselberghe, but to the fact that we had exceeded the distance that it was possible to satisfactorily use the telephone over iron wires.

As the company had copper wires extending from New York to Fostoria, Ohio, we moved our outfit to that point, and, not knowing what effect the various other wires within the city of New York, the cables across the Hudson River and other extraneous paralleling on the part of other systems might have, it was decided to make an experiment from Fostoria to Coeymans Station, N. Y., and Mr. Wm. Maver, an eminent electrician and electrical author, took charge of the experiments in person at that end of the line. The first test was made on copper wires—the gage of which I do not remember—at four o'clock in the morning, and I can still see in my mind's eye the delighted expression upon the professor's face, as its success was most pronounced.

Arrangements were then made with another company to, for a few days, trade some iron wires for copper, from Fostoria to Chicago, so that a test could be made from the Chicago to the New York terminal.

In Chicago the apparatus was placed in a room of the Palmer Hotel on Wabash avenue, and in New York in a room of the building No. 63 Broadway.

The results of the experiment were eminently satisfactory, and my recollection now is that telephonic communication was carried on over two wires, used under the method as above explained, at the same time that those wires were being operated for quadruplex telegraphing.

If one could have control of all the wires, or could arrange with the companies so that each one should graduate its circuits, the necessity for "transposition" of wires for telephonic purposes could be lessened; but, of course, that is a condition that will probably never be brought about. It is well, therefore, for those who are anticipating the employment of composite circuits to arrange that the circuits to be used for telephonic purposes be transposed as frequently as may be necessary along the route of the line, so as to render nugatory the effects of induction from the parallel wires. Having done this, the use of the graduator and the condenser will enable them to so modify the effects of the Morse current upon the particular wires which they propose to use in composite circuit, that success shall attend their efforts.

In more recent experiments made along this line, and for experimental purposes only, the station at which we wished to place one set of telephones was the terminal for a polar duplex having a battery of 125 volts; thus on reversal giving us a difference of potential of 250 volts. The other terminal was likewise fitted.

The other wire, which we proposed to use as one of the pairs, was one which was worked single Morse, with a battery of 150 volts at each terminal.

The line was not transposed sufficiently to keep from this composite circuit the inductive effects of the parallel lines so fully as we had wished. After fitting the circuit up in the way described, we were still bothered by the effects from the polar duplex, to which we had attached telephonic apparatus, and notwithstanding the graduator, which we had employed, the Morse signals were exceedingly noticeable.

We finally came to the conclusion that we suffered particularly, and the greatest at that moment when the points of the reversing keys were together, and there was a sharp break through maximum charge to earth, or vice versa. We therefore, after experiments in several directions, arranged our circuit as follows:

Upon the wire which was being worked duplex, we placed, immediately after the office instruments, two graduators in series, connecting between these two one terminal of a condenser, and connecting the other terminal to earth. This arrangement completely eliminated the bad effects of the Morse from that particular wire, and our other connections being made beyond these two graduators arranged in series, we were free from the effects of the signals on the duplex wire.

Up to this time, I have spoken of composite circuits wherein the telephonic arrangements are placed in what might be known (telephonically) as a metallic circuit. An arrangement can be made whereby a single wire may be made use of for a composite circuit. Of course, as must be clearly understood, the operation will not be so successful and pleasant to the ear, on account of the earth connections, and more or less inductive effects must be expected, and the results will be much less desirable than they are now found in straight telephone work upon a metallic circuit, as compared with a grounded circuit.

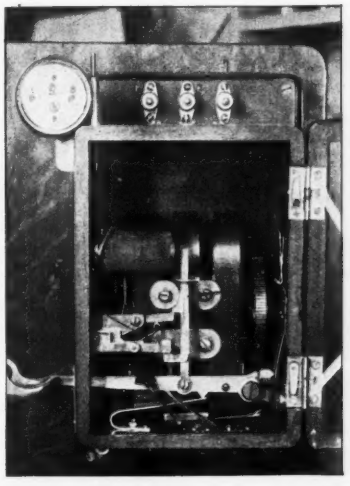
To make a single circuit composite we use the graduators, as before explained, and, going to a point on the line just beyond them, connect through the telephonic apparatus and the condenser to earth.

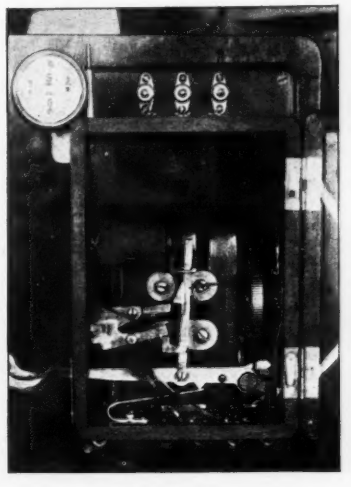
One thing desirable in the composite circuit (and up to this time I have not seen it evolved) is some sort of a signaling apparatus whereby the telephonic stations may signal from one to the other without interfering with the Morse circuits. At present in our experiments it is necessary for us to "call" on the Morse circuit in order to notify the parties to go to the telephone. Doubtless as the composite circuit becomes better understood, the inventive ingenuity of the American, which appears always to be at hand and always to arise when emergency occurs, will promptly supply this one missing link, which at present is beginning to be needed, and which in the future will certainly be to a large extent.

*A paper read before the eighteenth annual meeting of the Railway Telegraph Superintendents' Association, Wilmington, May 17, 1899.

A Novel Telephone Call Register.

Mr. H. T. Richards, of 225 West Twenty-eighth street, New York, has been granted a patent on a telephone register, which presents some new and valuable features. The object of this invention is to electrically and automatically record completed telephone calls simultaneously at the central office and the subscriber's station at the time such calls are made. Before describing this system it will be profitable to note the several methods of service offered to the public for local telephone service since the telephone became commercial. The first contract presented to the prospective telephone subscribers was what was called the "flat rate" or unlimited service contract, which enabled the subscriber, on payment of a stipulated sum, to use his telephone any number of times during the limit of his agreement, which was usually for one year. It was found, after several years of experience, that the rate charged under this contract precluded the use of the telephone in a universal sense, and that only the larger business firms could satisfactorily subscribe to the service. The telephone companies wisely decided that the destiny of the telephone demanded that it should be within the reach of all. The message rate contract was then inaugurated, and, at the present time, the public are invited to avail themselves of the facilities of the telephone service at a fixed charge per message. This was accomplished through the convenient medium of the pay station and the installation of telephones on the message basis in residences and places of business, which method practically means that the user only pays for the service that he actually receives. Since the operation of the message rate system the marvelous growth of the telephone business has demonstrated to the companies that this is the service the public demands It became necessary, under this system, for the telephone companies to keep a record of each completed message, in order that they might intelligently render statements to their subscribers based on the exact number of messages they had furnished. At first this was comparatively easy to do, but when it is considered that in New York city 70 per cent of the contracts with the subscribers are on the message rate basis, and that, with each message of such subscribers, a ticket must be written by the central-office operator at the time she furnishes the connections, giving the time and number of the subscriber calling, as well as the number of the subscriber called, it will not be difficult to see that such a system in the rush hours of the service might become somewhat involved. With the steady increase of patronage the telephone management has been alive to the fact that some automatic means of keeping the records would have to be resorted to, in order that the operator might have nothing to do but make connections when requested, thereby assuring prompt and efficient service to the public. The telephone companies keep all records of messages for their subscribers, but if a patron wishes to verify a statement of his message account, the companies cheerfully furnish the tickets covering the charges in question, which have been filed away for this purpose. How to abandon the writing of tickets so that the operator would be unhampered, and at the same time be able to furnish satisfactory evidence of services rendered to the subscriber, if questioned (the subscriber depending upon the telephone companies for the records), is the question which is now under advisement. It is the intention of Mr. Richards's invention to aid the telephone companies to furnish better and more rapid service by doing away with all the worry and work incident to the writing of tickets—at present the only way to settle disputed calls—as well as to furnish to the subscriber evidence at his own telephone of his own creation, which will be more satisfactory than seeing his tickets. This new method is described as follows: A register is placed at the subscriber's telephone in a position to be readily seen when operated, as shown in the accompanying illustration, and a corresponding register is located at the central office. When a subscriber is desirous of making a call, he calls up central in the usual way. If the number required is not busy, the central operator, before making the connections (automatically by her plug or by a push-button), projects a current, grounded at the central office, through the calling subscriber's register, at central, electrically moving the register one number ahead, and thence, through one of the wires composing the pair of the subscriber's circuit, out to the subscriber's telephone. In the subscriber's telephone is a circuit-breaker, which is normally open, but which is closed when the receiver is removed from the hook for purposes of conversation. While the receiver is off its support, the change of the position of this support puts into operative condition the grounded circuit from central and locks the registering mechanism to the receiver hook or support, so that when the subscriber, on finishing his conversation, returns his receiver to its hook, the downward movement of the receiver hook serves to operate the subscriber's register. The registering circuit referred to, after locking the subscriber's mechanism, is grounded at the subscriber's station, thereby completing the circuit. It will be seen by this method that the central office and subscriber's register must agree, as any manipulation of the telephone hook on the part of a subscriber disables the register controlling circuit, and renders the operator cognizant of the fact by the failure of her electrically-controlled register to operate. Inasmuch as the subscriber's register can only be put in an operative condition when he is at the 'phone, with his receiver off its support, the operator will be unable to work her register, or his locking mechanism, without his knowledge or in his absence. While the central operator actually manipulates her register herself, the subscriber, by his own act, when returning his receiver to its support, registers his messages for himself. If the operator by mistake should lock the subscriber's register to his receiver hook, while he would have to register on returning his receiver to its support, he can call up central at the time the mistake is made and have it rectified. This system virtually resolves itself into a registration of messages, depending on the mutual and definite acts of the telephone subscriber and the central-office operator.





FIGS. 1 AND 2.—A NOVEL TELEPHONE CALL REGISTER, SHOWING REGISTERING MECHANISM CONNECTED AND DISCONNECTED.

Deep-Sea Cable for the Philippines.

The United States cableship "Hooker," which was recently described in the ELECTRICAL REVIEW, has been reported at Gibraltar, and is well on her way toward Manila by way of the Suez Canal. As already stated in these columns, the "Hooker" is the first cableship ever sent out by the United States Government, and she is bound for the Philippines to lay cables connecting the several islands of the group and the various cities and towns of the larger islands.

Included in the deep sea cable equipment which the "Hooker" carried from this port are 30 miles of Kerite cable, manufactured by W. R. Brixey, of New York and Seymour, Ct. The core is made up of seven No. 21 Brown & Sharpe gage tinned copper wires stranded together. This core is covered with a thin layer of pure Para rubber, and then insulated with Kerite compound to an outside diameter of nine-thirty-seconds of an inch. Over this is a covering of tape. The core as now covered is laid up with jute and armored with 16 No. 11 Brown & Sharpe galvanized, mild steel, armor wires, and over the armoring are two reversed layers of tarred jute.

The complete cable weighs about three tons to the mile, and has an outside diameter of one inch. It was made in the Kerite plant at Seymour, Ct., and shipped, on reels in lengths of five miles each, to the Harlem dock, New York city, where it was joined in one length and loaded upon the "Hooker."

The manufacturers state that when the cable was placed aboard the ship an insulation resistance test showed 3,800 megohms per mile, although the specifications called for but 1,000 megohms and a break-down test of 5,000 volts.

New Push-Button Switches.

It would seem that the demand for push-button switches has been more than satisfied by the various types upon the market, and that very little improvement could be made in switches of this class. Like many other articles of manufacture in the electrical line, improvement can be looked for only in details, but the manufacturer who makes the most successful combination of improved details will have an article which will command a ready market. The "Diamond H" push-button switches just placed on the market by the Hart Manufacturing Company, of Hartford, Ct., have many points of merit claimed for them by the makers. It has been the aim of the manufacturers of these switches to answer objections cited in the past by engineers, wiremen and others against the various modifications of this general type of switch, by producing an article in which the points or principles objected to do not exist.

The main points that have been considered in the construction of this switch are: first, positive mechanism and good contacts with good wearing qualities of both; second, perfect insulation of the current-carrying parts, both between the terminals and from the other metal portions of the switch; third, ease and uniformity of movement and simplicity of mechanism. A lengthy description of the switch is unnecessary, but a few details of construction will be of interest to those whose experience with switches of this type has not been entirely satisfactory.

Fig. 1 shows the switch as a whole with a solid brass face-plate. The ears for attaching the switch to the wall or woodwork are recessed in the back of the face-plate, avoiding the necessity of cutting a recess in the wall for them. Fig. 2 is a 10-ampere double-pole switch with the face-plate removed. The mechanism and contacts are enclosed in a porcelain base, shown with the front side cut away. The switch-plates, one of which is shown in the illustration, are of the knife-switch pattern, and owing to the device for driving them into and out of the contact clips, a high velocity, and consequently a short arc is assured. The contact, Fig. 3, is of phosphor bronze attached to a brass upright, which carries the binding screw. The phosphor bronze clip is comparatively long and wide, which insures flexibility and firm pressure upon the end of the switch-plate. The spring, Fig. 4, is a simple coiled spring of comparatively large diameter, made of steel music wire, with upturned ends to engage the moving parts of the switch. It is so used

FIG. 1.

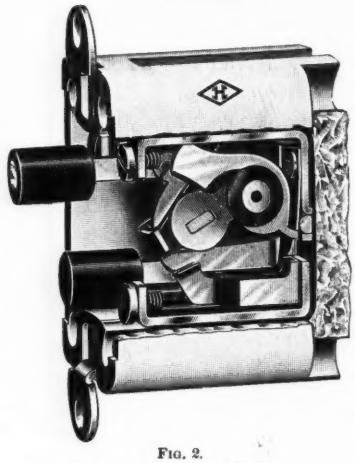


FIG. 2.

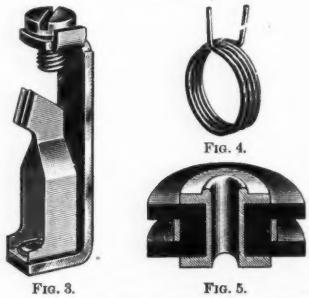


FIG. 3. FIG. 4. FIG. 5.

FIGS. 1-5—DETAILS OF A NEW PUSH-BUTTON SWITCH.

that no unnecessary strain is put upon it. The insulation of the current-carrying parts is effected by spools made of sheet mica, laminated, and held together by a central bushing. This spool is shown in section in Fig. 5. It is loosely mounted in an elongated opening in the switch-plate, and is driven by a pin through its central opening. The body of the spool is surrounded by a steel sleeve, thus preventing the edges of the opening in the switch-plate from cutting the mica. Mica being a practically perfect insulator, a non-absorbent of moisture, and unaffected by changes of temperature, is claimed to be the best material that can be used for this purpose. The movement of the buttons is smooth, and the pressure required is uniform throughout their travel, and nothing else has been sacrificed to secure this end. Details of less importance than those referred to have been carefully considered, and the result is a switch which the Hart Manufacturing Company believe to be thoroughly good and reliable.

Electricity at the United States Naval Proving Grounds, Indian Head, Md.

At Indian Head, on the Maryland shore of the Potomac River, a few miles below Washington, the Government has erected at the proving grounds a large plant for the manufacture of smokeless powder, the first factory of this sort to be built by the United States. Owing to the dangers inseparably connected with the manufacture of explosives, it is necessary that all sparking be eliminated, as far as possible, from the motors employed in the works. The power transmission which will be used about the works will be entirely by means of polyphase motors, their size ranging from five to 30 horsepower. On account of the presence, in many of the buildings wherein the powder manufacture is conducted, of acid fumes, it is necessary that motors of the enclosed type, having the least possible surface of copper exposed to the acids, be used. Both these conditions are met by the type of polyphase motor which is being installed by the Westinghouse Electric and Manufacturing Company, of Pittsburgh.

In the central power-house there are two 250-kilowatt generators, designed to furnish direct current at one end of their armatures and polyphase current at the other. The direct current is at 550 volts, and is used for the traction lines, while the alternating current lights the mills, offices and dwellings, and operates the power circuit in the powder mills. In addition to these there is one 75-kilowatt polyphase generator, all of the dynamos being direct-coupled to individual engines of the Westinghouse type. The generators can be worked in multiple at either end or at both ends simultaneously. The 75-kilowatt machine can be used as an auxiliary to the alternating-current end of the larger generators, or driven by itself to supply light and power in the powder-mill circuit.

The electric traction system has some points of novelty. About three and one-half miles of track are used for the transportation of raw materials and finished products between the powder mills and the dock. Three electric locomotives, one of 50 horsepower and the other two of 100 horsepower each, operate the lines. The proving grounds cover several acres, and are used for testing guns, projectiles, armor plate, etc. The electric railway, where it approaches the dock, crosses the firing line for the test of artillery, and for half a mile the trolley has been abandoned and the Westinghouse electro-magnetic track contact system has been adopted. This was because the trolley wire would be destroyed by projectiles and flying fragments during the tests of cannon. The installation is complete in every particular, and probably represents the first application of electric power in the manufacture of high explosives.

BUSINESS NOTES.

The Pittsburgh Transformer Company, of Pittsburgh, Pa., is sending out well prepared and handsomely illustrated catalogues describing its type "K" transformer.

Rossiter, MacGovern & Company, 141 Broadway, New York, offer for sale an extensive line of second-hand engines, generators, boilers, shafting, pipe, pumps and belting, all in first-class shape, which they have obtained from the several different electric lighting plants which are to be replaced by a new plant in Washington, D. C.

The Illinois Electric Company, 139 Madison street, Chicago, are at work on a new telephone catalogue, which will be ready for distribution about July 1. They state that this will be the most complete catalogue ever issued, and ask the trade, if they do not receive a copy on or before July 10, to kindly send their card, and they will send a copy free of charge.

A New Storage Battery Company.

The Perret Storage Battery Company, of New York city, was incorporated at Albany, N. Y., on May 20, with a capital of $100,000, to manufacture storage batteries and all kinds of electrical appliances. The directors are Frank A. Perret and Robert R. Clayton, of Brooklyn, and Omri F. Hibbard, J. Lester Hornicker and Walter I. McCoy, of New York city.

A New Type of Compound Engine.

This engine is a compound of a new type, which has been named the "Duplex Compound." The advantages of this engine over other styles of compound are, first and chiefly, the small floor space it occupies, being no more than that taken by the simple engine. Next in importance, perhaps, is the arrangement of cylinders and valve, which gives an unusually fine steam distribution and insures a minimum of condensation losses both in the cylinder and the receiver. As a result of this arrangement, the cost of developing electric currents may be materially reduced in office buildings and other similar locations where the scarcity of room has not heretofore made it practicable to use compound engines. The indicator diagrams produced by this engine show a remarkably constant-receiver pressure at all stages of load, and it is also interesting to notice the exact division of work between the pistons under various conditions of load. This last feature may be interesting to those who raise any question as to the mechanical success of connecting the two pistons to one cross-head, although if an examination of the cross-head is made, it will be evident that, owing to the fact that it is about double the length of the stroke of the engine and is designed with special reference to great strength and rigidity, it is a matter of no special consequence whether the work is divided between the pistons or not. On the score of economy of steam it is no doubt desirable to maintain a constant-receiver pressure and an even division of work between the cylinders. The general features of the engine outside of the cylinders and valve and cross-head are the same as the engines heretofore built by the American Engine Company, who are the makers of the new compound, and with which the public is familiar. The generator accompanying this engine is of the latest style of six-pole machines, making a complete generating set in which a large amount of current may be developed from a machine occupying a small space and showing a high efficiency in current developed per pound of coal consumed. The pistons are very accessible, more so than in a tandem-type compound. The generating set described above is on exhibition at the electrical show in Madison Square Garden, where it is attracting much attention.

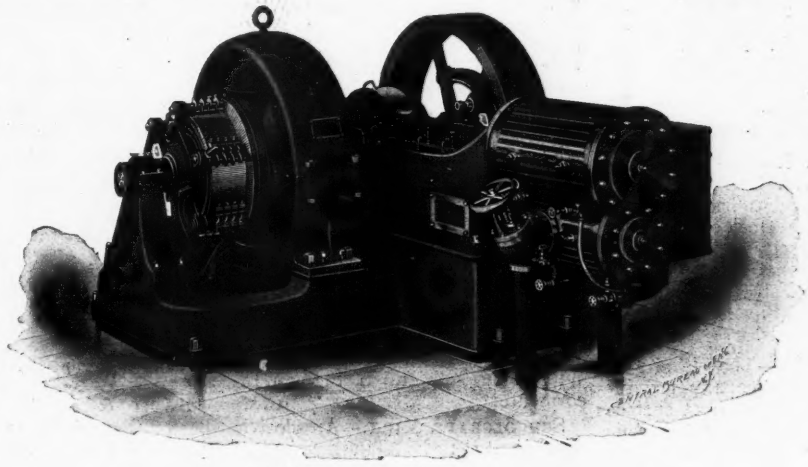


FIG. 1.—A NEW TYPE OF COMPOUND ENGINE.

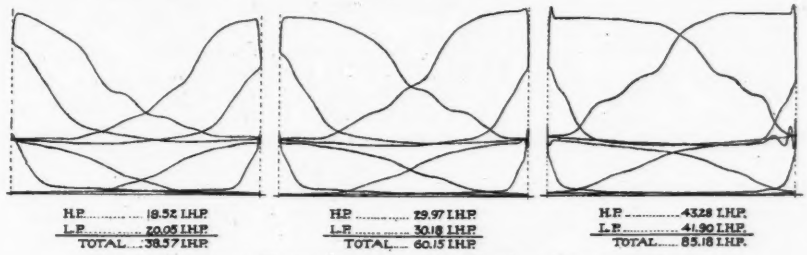


FIG. 2.—INDICATOR DIAGRAMS FROM A NEW TYPE OF COMPOUND ENGINE.

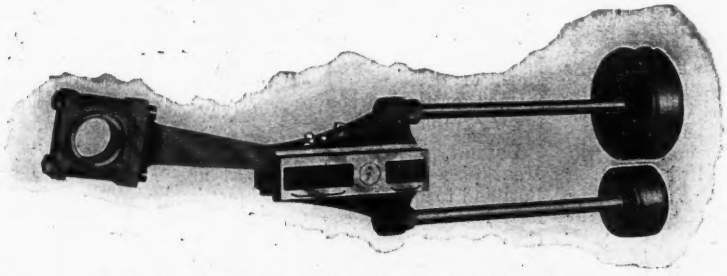


FIG. 3.—PISTONS OF A NEW TYPE OF COMPOUND ENGINE.

American Institute of Electrical Engineers.

As announced in the ELECTRICAL REVIEW last week the annual business meeting of the institute was held on May 16, and officers for the ensuing year were elected. The total membership on May 1 was 1,135, being a net gain of 35 during the year. The cash balances on hand and in various funds amount to $5,702.74, and other assets amount to $5,067.75.

At a meeting of the executive committee, held in the afternoon of May 16, 18 associate members were elected, and Messrs. Arthur E. Kennelly and Henry A. Lardner were transferred to membership. The general meeting of the institute will be held on June 26, 27 and 28 at Boston.

The paper on "The Multiple Unit System of Electric Railways," which was read by Mr. Frank J. Sprague, past president, and fully illustrated by a working model and lantern slides, was discussed by Messrs. John B. Blood, Jr., A. H. Armstrong, H. Ward Leonard, F. V. Henshaw and others.

A NEW CENTRAL ENERGY TELEPHONE GENERATOR.

A New Central Energy Telephone Generator.

In the illustration herewith is shown a new type of central energy telephone generator which has been designed by the Eureka Electric Company, of Chicago, to take the place of hand generators in telephone exchanges. This generator is especially adapted for exchanges where water-power is unavailable or where the charges for power are prohibitive. The manufacturers state that four cells of any type of sal ammoniac battery will furnish sufficient current to enable the operator to ring bells over lines having resistances as high as 100,000 ohms. The device requires no attention except occasional recharging of the batteries. One strong claim made by the manufacturers for this generator is that it consumes no current except when signaling a subscriber. The device is adapted for either series or bridging bell lines, and for any size exchange from 25 subscribers upward. The size of the generator is 10 by 12 inches, and it can be placed in any convenient place either at the switchboard or away from it.

On request the manufacturers will mail free a full description of this generator.

ADVANCE INFORMATION

New Telephone and Telegraph Companies.

KINSON, ILL.—The Henry County Telephone Company has been incorporated; capital stock, $2,500; incorporators, W. D. Colby, W. H. Cosner and Isaac Piele.

GALLIPOLIS, OHIO—The Gallipolis Telephone Company has been incorporated; capital, $30,000; incorporators, A. L. Bigelow, Thomas E. Bradbury, William B. Shober, W. W. Morrison, C. N. Henking, all of Gallipolis.

MT. STERLING, OHIO—The Mt. Sterling Telephone and Electric Company has been incorporated; capital, $6,000; incorporators, Clay Johnson, O. W. Loofborrow, I. S. Henkle, W. R. Richards, J. A. Miller, all of Mt. Sterling.

ELLICOTT CITY, MD.—The Citizens' Telephone Company has been incorporated here, with William Davis, James H. Gaither, Louis T. Clark, Frederick H. Balliere, and J. Seymour T. Waters as incorporators; $5,000 is the amount of the capital stock. It is proposed to construct and operate telephone lines within the state of Maryland, and particularly to establish a system of intercommunication through an exchange in Ellicott City.

YANKTON, S. D.—A new telephone company has been organized at Tyndall, 28 miles northwest of here, with Dr. Berry, of that place, at its head. Bon Homme County will be crossed from Scotland to Springfield, and branches will extend from Tyndall to a number of small villages, including Tabor, Avon, Morrison and the Yankton agency.

SALEM, MASS.—The Salem Telephone Company has been incorporated; capital, $100,000; incorporators, Henry A. Hale, Joseph M. Parsons, George W. Pitman.

FRANKFORT, KY.—The Winchester Telephone Company, with a capital stock of $3,000, has been incorporated. D. L. Pendleton and others are the incorporators.

BEAVER SPRING, PA.—The Spring telephone company has been incorporated with a capital stock of $2,000.

LEXINGTON, TENN.—A new telephone line has been completed from Lexington to Decaturville and all intervening points. The promoters of the enterprise are local capitalists.

ST. JOHNSBURY, VT.—The New England Telegraph and Telephone Company is rebuilding its line to Cambridge Junction.

LAWRENCE, MASS.—The Home Telephone and Telegraph Company has been incorporated. President, Edwin W. Barton; treasurer, Geo. G. Adams; capital stock, $100,000.

TAUNTON, MASS.—The Taunton Telephone Company has been incorporated. President, Peter H. Corr; treasurer, Clinton Sproat; capital stock, $50,000.

SEDALIA, MO.—A telephone line is to be built between this place and Longwood, 16 miles, by popular subscription. All but about $50 of the amount necessary has been subscribed.

LOUISVILLE, KY.—The Calloway Telephone Company has been organized, and an exchange will be put in within 60 days at Murray, connecting Mayfield, Paducah, Fulton, Hickman and other places, in addition to the local system.

New Electric Railways.

LOCKPORT, N. Y.—The Perry, Castile, Pike & Silver Springs Electric Railway Company has been incorporated, with a capital stock of $200,000. It purposes to operate an electric railway through Wyoming County, connecting Genesee Falls, Pike, Castile, Perry, Gainesville, Silver Springs and probably other towns.

ELMIRA, N. Y.—The Elmira & Corning Railway Company has incorporated to operate a street surface electric road 18 miles long from this place to Corning. The principal office will be in Elmira. The capital is $200,000 and the directors are Hiram B. Rhymer, John M. Diven, Clinton M. Paul, Wallace W. Seeley, Charles A. Allen and Edwin S. Brown, of Elmira; Peter T. Marshall, of Horseheads; James L. Rhymer, of Philadelphia, and John R. Minier, of Big Flats.

PETERSBURG, VA.—The contract for building the new street electric railway here has been awarded to Jas. F. Bradley, of Manchester, Va. Breaking of ground for the road will be begun next week, and 200 men will be employed. Over $30,000 will be paid out for labor in the construction of the road.

NILES, MICH.—Chicago capitalists will build an electric railroad from Cassopolis via Dowagic and Sister Lakes to Benton Harbor, where it will connect with the South Haven & Saugatuck Line. The arrangements for making the survey and purchasing the right of way are now in progress.

BUCKLEY, WASH.—The owners of the Natchez Pass Railroad contemplate the extension of the line about six miles eastward into the timber belt this Summer.

CALUMET, MICH.—The Calumet & Hecla Mining Company has granted a franchise to John D. Cuddihy and Edward Ryan, of this city, to build an electric street-car line through their property and connecting the cities of Laurium and Red Jacket.

SELLERSVILLE, PA.—The Inland Traction Company has secured a complete right of way from Perkasie to Lansdale. The new trolley line will parallel the Bethlehem branch of the Reading Railway, passing through Sellersville, Telford, Reliance, Souderton, Hatfield to Lansdale. Messrs. Pascoe & Crilly, of Allentown, the promoters, have just awarded the contract to build the road to Gleason & Keely, of Syracuse, N. Y.

LANSING, MICH.—The Port Huron, St. Clair & Marine City Electric Railway has been incorporated, with a capital stock of $300,000.

IRWIN, PA.—The Westmoreland Traction Company, composed of Irwin capitalists, has been incorporated to operate a trolley line between this place and Manor, with the possibility of extending branches in other directions The line between the points named will be two and three-fourths miles, and the cost of construction about $20,000 per mile. The company contemplates purchasing the power-house at Manor. The work will be completed before next Fall.

Electric Light and Power.

PAONIA, MASS. — The Paonia Water and Light Company has been incorporated; capital, $10,000. W. A. Clark, Milton Spencer, J. F. Wanamaker, E. J. Matthews, A. B. Williamson and Ira L. Sigman incorporators.

SCHOOLCRAFT, MICH.—An electric light plant is to be established at this place.

BRADDOCK, PA.—The Braddock Gas and Light Company, which furnishes light for Braddock, Rankin, North Braddock and Turtle Creek, and Homestead Electric Light Company have consolidated. W. W. McCleary is general manager.

WINONA, TENN. — The Town Council has closed a contract with a Chattanooga firm to put in an electric light plant here. The streets are to be lighted by September 1.

FROSTBURG, MD. — The electric light and gas plants at this place have been consolidated, the purchase of both having been made by Marx Wineland, Roberdeau Annan and Duncan Sinclair, of Frostburg, and Robert R. Henderson and Daniel Annan, of Cumberland.

WATERVILLE, MINN.—The franchise for 25 years for an electric light plant was accorded to Brown & Company, of Knoxville, Tenn.

New Incorporations.

BALTIMORE, MD.—The Baltimore Telephone Construction Company has been incorporated by William H. Martin, Pinkney W. Wilkinson, Charles J. Taylor, Harry W. Rogers and Jessie Slingluff, with a capital stock of $10,000. The company is formed for the purpose of constructing telegraph lines.

BOSTON, MASS. — The Antiseptic Mouthpiece Company, organized at Portland to manufacture mouthpieces for telephones, has been incorporated; the capital stock is $100,000. Gideon M. Mansfield, of Boston, is president, and Charles H. Hutchings, of Boston, treasurer. The other incorporators are Charles J. McCormack, A. W. Lawrence and Charles E. Folsom, of Boston.

NEW YORK, N. Y.—The American Electrical and Maintenance Company has been incorporated; capital, $50,000; directors, Alfred K. Warren, F. James Reilly and Wm. F. Reilly, of New York city.

Increase of Capital.

HARTFORD, CT. — The Hartford Electric Light Company has increased its capital stock from $200,000 to $700,000.

BUSINESS NEWS.

Mr. Benjamin Rose has closed a contract with the Western Electric Company, of Chicago, to install a complete electric light plant in the Rose Building, Cleveland, Ohio.

The United States Express Company has ordered for its building, 87 to 89 East Washington street, Chicago, a 30-kilowatt Western Electric direct-connected generator. The plant will be used for running 400 16-candle-power incandescent lamps.

Swett & Lewis Company, of Boston, have been compelled, by the growth of their business, to seek larger quarters, and have removed from 11 Bromfield street to 79 Franklin street. They will continue to manufacture their well known line of static machines and X-ray supplies, and, in addition, will carry in stock a full line of galvanic and faradic goods, light, cautery and epilation outfits, dry and wet cells, electrodes, and everything pertaining to electro-therapeutic and X-ray work.

The Electric Arc Light Company have removed their general offices to large and commodious quarters in the Bowling Green Building, 11 Broadway, New York. They have largely increased their manufacturing facilities, and can promptly ship direct and alternating-current, enclosed arc lamps. W. C. Hubbard, general manager, reports that they are very busy at present, and have just closed some good orders with the following: W. & J. Sloane, Ogden Goelet Estate, Central Railroad of New Jersey in New York, Palais Royal, Washington, D. C.; Campbell & Smith, Herren Brothers, John Daubs & Sons, Pittsburgh, Pa., etc.

The Ward Leonard Electric Company announce a reduction in the price of their Carpenter enamel field rheostats and theater dimmers. This reduction is as much as 30 per cent in most instances. This cut in price is in strict conformity with the well known practice of this company of making reductions in price as soon as they are enabled to do so, and still maintain a reasonable profit. The Ward Leonard company state that they have made such radical improvements in their costs, due to new design and production in very large quantity, that they find that they can make the present large reduction in price and still make fair manufacturing profit. The company's foreign orders, already very large, will no doubt increase rapidly on account of the low price and high standard of quality.